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SECOND ANNUAL REPORT

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No. 8

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Circle West Wildlife Monitoring Study

Third Annual Report

For the Period March 1, 1980 - February 28, 1981

Circle West Technical Report No. 8

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INTRODUCTION

This report describes results of the third year of the Circle West wildlife monitoring study, coordinated by the Montana Department of Natural Resources and Conservation (DNRC), as described in the Circle West Wildlife Baseline Study Final Report (DNRC 1978) and the first and second wildlife monitoring reports (DNRC 1979, 1980). The report period extended from March 1, 1980, through February 28, 1981.

STUDY AREAS AND OBJECTIVES

Study efforts during this period were primarily limited to the 113-section Mine Study Area, as described in the second monitoring report (DNRC 1980). Within this area, the most intensive study occurred in the 31.5-section Permit Area, defined on January 23, 1980. This Permit Area includes the original 11.5-section Proposed Mining Area, plus additional areas to the northeast and southwest that are being considered for coal strip mining or associated development (see Figure 1 in DNRC 1980). Some work was conducted in the Reconnaissance Study Area (see Map 1 in DNRC 1978), which includes most of McCone County.

A primary goal of this monitoring study was to conduct a 12-month wildlife investigation in these new areas which would provide a level of baseline data comparable to that presented in the wildlife baseline study (DNRC 1978) for the original 11.5-section Proposed Mining Area. Wildlife information also was sought for a 14-section portion of the Mine Study Area added in January 1980 to provide a "buffer zone" around the new Permit Area.

In much of this report, data are treated separately for the old Proposed Mining Area, the Permit Area, and the Mine Study Area. To facilitate data analysis, the Permit Area was broken into three sections: the old Proposed Mining Area (labelled "X" on the field maps and data sheets), the three additional sections to the southwest (labelled "Y"), and the 17 additional sections to the northeast (labelled "Z") (see Figure 1 in DNRC 1980).

APPROACH

This monitoring study focuses on a few key parameters which are indicators of overall environmental conditions and year-to-year fluctuations or trends and are believed to be especially sensitive to mine-related impacts, cost-effective for the amount of field work required, and capable of being measured quantitatively with an acceptable degree of accuracy and with a minimum of "noise" or unexplained fluctuation. This approach allows both a yearly updating of the data gathered during the baseline study and a measurement of long-term trends and variability at minimum cost. The quantitative parameters selected for the long-term monitoring were listed in the second monitoring report (DNRC 1980).

METHODS

Field techniques and analytical methods for this third year of monitoring followed those described in the wildlife baseline study final report (DNRC 1978). Four biologists worked in the study area at various times during the study period. A total of 86 person-days was spent conducting ground surveys in and near the Mine Study Area by project biologists (Appendix A). An additional 11 person-days were spent carrying out aerial surveys. A brief summary of methods employed for individual study segments follows.

GENERAL AERIAL AND GROUND SURVEYS

With the exception of August 1980 and January 1981, monthly aerial surveys were made of the Mine Study Area from March 1980 through February 1981. Ground surveys were conducted in all months. All observations (both ground and aerial) of large mammals, upland game birds, and raptors were recorded on the type of data sheets and maps used during the original baseline study (DNRC 1978). Locations of all recorded observations within the Mine Study Area were plotted on maps at a scale of 1:24,000. All data (including data sheets and field maps) are on file with DNRC.

WATERFOWL SURVEY AND CENSUS

All waterfowl observations were recorded on waterfowl data sheets similar to those used in the baseline study. In addition, censuses were taken of bodies of water in the Mine Study Area three or more times during the study period, using methods described in the first monitoring report (DNRC 1979). A computer program was developed to analyze the waterfowl data, and work on documenting the program and preparing a user's guide began.

MONITORING OF RAPTOR NESTS AND GROUSE LEKS

Raptor nests located in the Mine Study Area were visited in May, June,and July to determine if eggs or hatchings were present. Also, leks in the Mine Study Area were visited in March and April to determine the number of grouse present.

ROADSIDE WILDLIFE SURVEY

Each of the five roadside wildlife survey routes were run in May, June, and July 1980, using methods outlined in the baseline study. Surveys were run on dates which corresponded closely with the 1977 survey dates. A number of diversity measures and other community parameters were determined for each route and for the five routes combined. The average sample abundances of each indicator species , as well as various community parameters, were plotted to graphically portray the nature and magnitude of year-to-year fluctuations.

SMALL MAMMAL TRAPPING

The 12 small mammal traplines sampled in 1979 (numbers 15, 17, 18, 20, 33, 34, 35, 44, and 46-49) were snap-trapped for three consecutive nights in May and again for three consecutive nights in October. Methods followed those outlined in the baseline study.

LAGOMORPH SURVEY

The two lagomorph survey routes were run consecutively on each of three mornings (October 30, November 1 and 2) beginning with the mining area route at 04:00.

WEATHER

Annual precipitation, growing season (April-July) precipitation, and winter (November-March) precipitation data were compiled from weather stations to document moisture availability for vegetation and waterfowl, as well as the amount of winter precipitation, which influences snow cover. Average January and July temperatures were monitored as well, since they relate to the amounts of thermal stress experienced by wildlife during the months that typically have the lowest and highest average temperatures. A "severe" winter can be identified as one with lower than normal January temperatures and higher than normal November-March precipitation (for example, the winter of 1978-79).

Figures 1 and 2 summarize year-to-year weather changes at the Circle and Fort Peck recording stations. Spring and summer 1980 were much drier than normal; precipitation was similar to that in 1979, a drought year. Both annual precipitation and growing season (April-July) precipitation were well below normal at the Circle and Fort Peck recording stations (Figure 1). Because much of the summer precipitation comes from isolated thunderstorms, precipitation in the study area can be markedly different than at these two stations. Although precipitation gauges were not installed in the study area until after the monitoring period ended, Prodgers (1981) estimates that only 1.5 inches of precipitation fell on the study area from January through July 1980. By comparison, 1980 growing season (April-July) precipitation at Circle and Fort Peck was 4.15 inches (10.5 cm) and 3.12 inches (7.92 cm), respectively (Figure 2). Total 1980 precipitation in the study area was estimated to be less than 8 inches (McKeever, pers. comm.); this compares to a total 1980 precipitation of 11.26 inches (28.6 cm) at Circle and 7.73 inches (19.6 cm) at Fort Peck. The summer of 1980 was the second consecutive summer that the area experienced drought conditions. Average July temperatures were near normal (Figure 1). The winter of 1980-81 was quite mild, with very little snowfall and essentially no snow cover in the Mine Study Area. Winter precipitation (November 1980-March 1981) was near or below normal at Circle and Fort Peck (Figure 2) and was similar to that of the previous winter. Average January 1981 temperatures were an unusual 15 degrees F above normal (Figure 1).

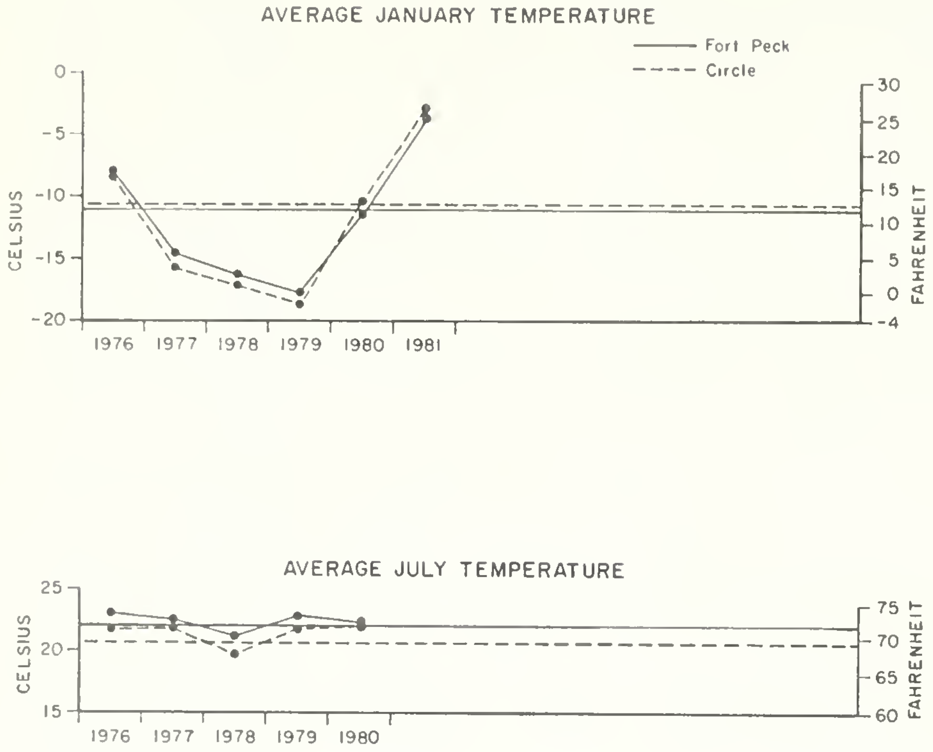

Figure 1. Year-to-year changes in temperature parameters at Circle and Fort Peck recording stations.

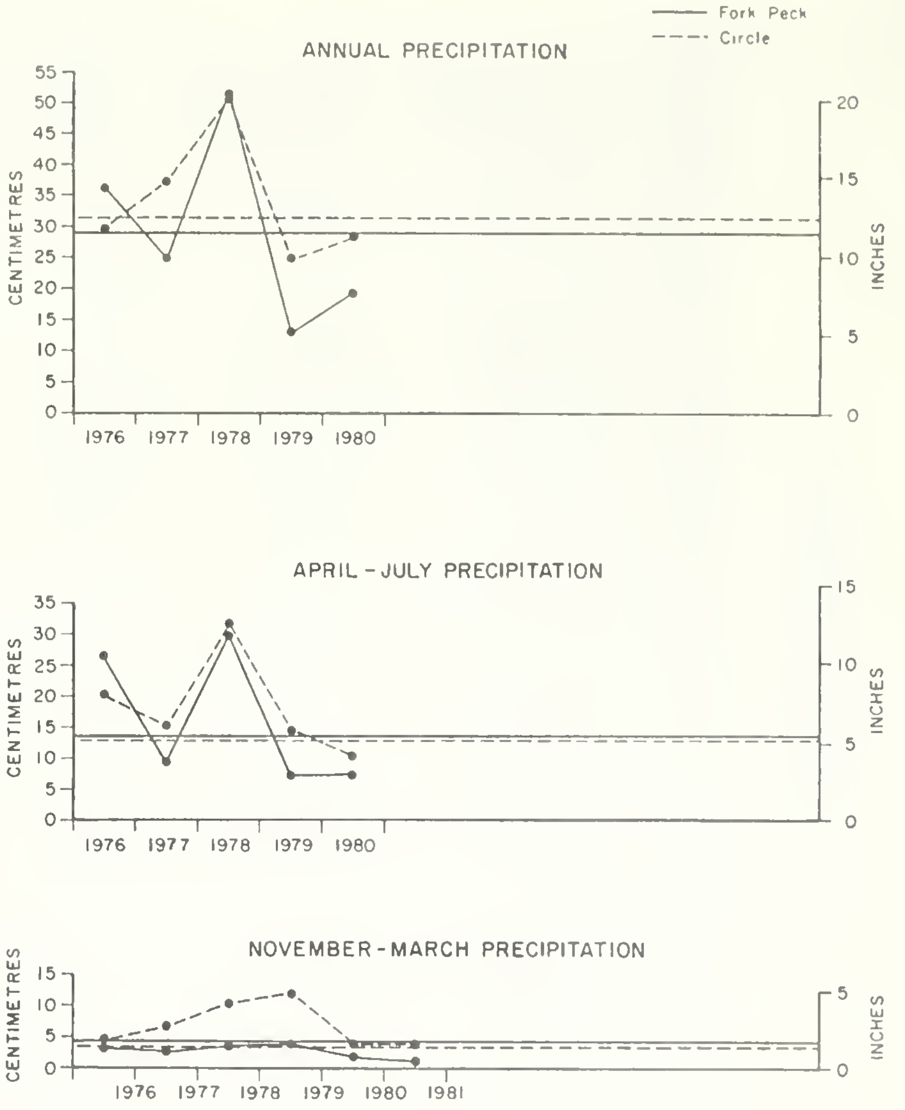

Figure 2. Year-to-year changes in precipitation parameters at Circle and Fort Peck recording stations.

VEGETATION AND HABITATS

A quantitative description of changes in vegetation from 1977 to 1980 was presented in the 1980 vegetation monitoring study annual report (Prodgers 1981). Due to drought conditions in 1980, net aerial production for most grassland communities was generally as low or lower than that recorded for the last severe drought year, 1977. The decline in production from 1978, a year of exceptionally high production, to 1980 was most apparent in western wheatgrass and needle-and-thread; blue grama did not show a clear variation (Prodgers 1981). Residual grass cover from 1979 was far less than from 1978.

RESULTS AND DISCUSSION

WILDLIFE SPECIES PARAMETERS

Tabular Summary

Two-hundred and nine species of vertebrates have been observed in the study areas since the studies began in 1976 (5 amphibians, 7 reptiles, 169 birds, and 28 mammals). Data on these vertebrates are summarized in Tables 1 and 2. Any additions or changes to the data base resulting from the third year's monitoring study are printed in italics. The types of data included and the abbreviations used in these tables are as follows:

Habitat in Which Observed. Abbreviations correspond to habitat categories defined in Appendix B. The major habitats in which animals were observed during this study are listed in approximate order of decreasing use or indicated preference. Habitats merely crossed by birds in flight or transient mammals are not listed. "Various" indicates use of many different habitats without a clear preference.

Distribution. Numbers correspond to the three study areas described in the text: 1 indicates the Permit Area; 2, the Mine Study Area (excluding the Permit Area); and 3, the Reconnaissance Study Area (excluding the Mine Study Area). A number in this column indicates a sighting in the corresponding study area.

Classification. In its 1973 Red Book, the U.S.D.I. Bureau of Sport Fisheries and Wildlife identified certain species of animals as endangered (E), threatened (T), or status-undetermined (U). Although the classifications reported in the Red Book have been supplanted by the Endangered Species Act of 1973, they still provide a good index of vulnerability to extinction and are listed here. In addition, the Montana Department of Fish and Game (1977), now the Department of Fish, Wildlife and Parks (DFWP), has classified wildlife species as game species (G), nongame species (N), furbearers (F), and migratory game birds (M), and the National Audubon Society has listed in its "Blue List" (Tate 1981) certain species of birds that are experiencing regionwide or continentwide noncyclic population declines (B). Classifications under each system are indicated by the appropriate letter abbreviations.

Evidence. Acceptable evidence for including a species in this table, in order of decreasing reliability, is as follows: S indicates specimen(s) taken (number of specimens, or "P" if partial specimen, is given in parentheses); P, photograph taken; V, visual (sight) record; A, auditory (sound) record; B, reported by biologist(s) other than those directly involved in this study; R, reported by local residents. Only the most reliable evidence is listed in the table.

Guild (Birds Only). Breeding-season guilds (or nonbreeding-season guilds for winter residents and migrants) are indicated by a four-digit code. The first digit indicates major food source or feeding habits: 1 indicates seeds and vegetation (75% of diet); 2, invertebrates; 3, omnivorous (25-75% plant material); 4, vertebrates; 5, carrion. The second digit indicates foraging stratum: 1 indicates bark or bole; 2, ground, grass, and low shrubs; 3, tall shrubs or low forest canopy; 4, mid-to-high forest canopy or tall trees; 5, air; 6, water. The third digit indicates foraging strategy: 1 indicates bark or bole drilling; 2, bark or bole gleaning; 3, ground and brush foraging; 4, tree

Table 1. Summary of inventory data for bird species observed in the Circle West study area, June 1976 - February 1981 (see text for explanation of abbreviations)

Species	Preferred Habitat	Distribution[1]	Guild	Classification	Status	Evidence	Monthly Occurence Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Common Loon (Gavia immer)	PR	-,2,-	4680	BN	M	V	-	-	-	*T*	T	-	-	-	-	-	-	-
Horned Grebe (Podiceps auritus)	PR	1,2,-	2680	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Eared Grebe (Podiceps nigricollis)	SW,PR	1,2,3	2682	N	S(NE)	P	-	-	-	*T*	T	T	T	T	-	-	B	-
Western Grebe (Aechmophorus occidentalis)	SW	-,2,3	4680	BN	M	V	-	-	-	-	*T*	T	-	-	-	T	-	-
Pied-billed Grebe (Podilymbus podiceps)	PR	1,2,3	2682	N	S(PJ)	V	-	-	-	*T*	T	T	T	-	T	T	-	-
White Pelican (Pelecanus erythrorhynchos)	SW	1,2,3	4680	BN	V	V	-	-	-	B	T	T	B	-	-	-	-	-
Double-crested Cormorant (Phalacrocorax auritus)	SW,PR	1,2,3	4687	BN	S(NY)	V	-	-	-	B	B	B	B	T	-	T	-	-
Great Blue Heron (Ardea herodias)	FW,SW,SH, PR,SM	1,2,3	4677	BN	S(NY)	V	-	-	-	B	B	B	B	B	B	T	-	-
Black-crowned Night Heron (Nycticorax nycticorax)	*PR,SM*	*-,2,-*	*4677*	*BN*	*V*	*V*	-	-	-	-	*T*	*T*	-	-	-	-	-	-
American Bittern (Botaurus lentiginosus)	SM,PR	1,-,-	2670	BN	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Canada Goose (Branta canadensis)	PR,FW,SW, SH,CU	1,2,3	3647	M	S(PJ)	V	-	-	B	B	B	B	B	B	B	B	B	-
Mallard (Anas platyrhynchos)	PR,FW,SG	1,2,3	3674	M	S(PJ)	V	-	*T*	B	B	B	B	B	B	B	B	B	-
Gadwall (Anas strepera)	PR,SG	1,2,3	3674	M	S(PJ)	V	-	-	-	B	T	B	B	B	B	B	B	-
Pintail (Anas acuta)	PR,FW	1,2,3	3674	M	S(PJ)	V	-	-	B	B	B	B	B	-	-	-	-	-
Green-winged Teal (Anas crecca)	PR	1,2,3	3674	M	S(PJ)	V	-	-	B	B	B	B	B	-	B	B	B	-
Blue-winged Teal (Anas discors)	PR,FW,SA	1,2,3	3674	M	S(PJ)	V	-	-	-	B	B	B	B	T	B	B	T	-

Table 1. (cont'd)

Species	Preferred Habitat	Distri- bution	Guild	Class- ifi- cation	Status	Evi- dence	Monthly Occurence Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cinnamon Teal *(Anas cyanoptera)*	*PR*	*1,2,-,*	*3674*	*M*	*S(RH)*	*V*	-	-	-	-	-	*T*	-	-	-	-	-	-
American Wigeon (*Anas americana*)	PR,FW,SH	1,2,3	3674	M	S(PJ)	V	-	-	B	B	B	B	T	T	B	B	B	-
Northern Shoveler (*Anas clypeata*)	PR,FW,SM, SH	1,2,3	3674	M	S(PJ)	V	-	-	B	B	B	B	B	B	-	-	-	-
Redhead (*Aythya americana*)	PR	1,2,3	3682	M	S(PJ)	V	-	-	B	B	T	T	T	-	-	B	-	-
Ring-necked Duck (*Aythya collaris*)	PR	1,2,-	3680	M	M	V	-	-	B	T	T	T	-	-	*T*	B	B	-
Canvasback (*Aythya valisineria*)	PR	1,2,3	3682	BM	S(PJ)	V	-	-	-	B	T	B	T	-	-	B	B	-
Lesser Scaup (*Aythya affinis*)	PR,SH	1,2,3	3684	M	S(RH)	V	-	-	B	B	B	T	T	-	-	-	-	-
Common Goldeneye (*Bucephala clangula*)	PR	-,2,3	3680	M	M	V	-	-	B	B	-	T	-	-	-	-	-	-
Bufflehead (*Bucephala albeola*)	PR,SW	-,2,3	3680	M	M	V	-	-	-	B	T	-	-	-	-	B	B	-
Ruddy Duck (*Oxyura jamaicensis*)	PR	1,2,3	3682	M	S(CO)	V	-	-	-	-	*T*	B	B	-	-	*T*	-	-
Hooded Merganser (*Lophodytes cucullatus*)	PR	-,2,-	4680	M	M	V	-	-	-	T	T	T	-	-	-	-	-	-
Common Merganser (*Mergus merganser*)	PR,SW	-,2,3	4680	M	M	V	-	-	B	B	-	-	-	-	-	T	-	-
Red-breasted Merganser (*Mergus serrator*)	PR	-,2,-	4680	M	M	V	-	-	-	B	-	-	-	-	-	-	-	-
Turkey Vulture (*Cathartes aura*)	BA,SC	1,2,3	5233	BN	S(AN)	V	-	-	-	-	T	B	B	B	-	-	-	-
Sharp-shinned Hawk (*Accipiter striatus*)	CF,CU,TL	-,2,3	4267	BN	S(RH)	V	-	-	-	B	-	-	-	-	T	B	-	-
Red-tailed Hawk (*Buteo jamaicensis*)	Various	1,2,3	4267	N	S(PJ)	P	-	-	-	B	B	B	B	B	B	B	-	-
Swainson's Hawk (*Buteo swainsoni*)	GR,CU,SC, TL,FR,SG	1,2,3	4267	BN	S(NY)	V	T	-	-	B	B	B	B	B	B	B	-	-
Rough-legged Hawk (*Buteo lagopus*)	GR,CU,BA TL,SG,LB	1,2,3	4260	N	W	V	B	B	B	T	-	-	-	-	-	B	B	T

Table 1. (cont'd)

Species	Preferred Habitat	Distri-bution	Guild	Class-ifi-cation	Status	Evi-dence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ferruginous Hawk (Buteo regalis)	GR,BA,SC, FR,TL,HJ	1,2,3	4263	BNU	S(PJ)	P	-	-	-	T	T	B	B	B	-	-	B	B
Golden Eagle (Aquila chrysaetos)	Various	1,2,3	4263	N	R(PJ)	P	B	B	B	B	B	B	B	B	B	B	B	B
Bald Eagle (Haliaeetus leucocephalus)	CF,SH,CG	1,2,3	4660	E	W	V	T	B	B	-	-	-	B	-	-	-	B	B
Marsh Hawk (Circus cyaneus)	WM,SR,GR, SS,LC,SG	1,2,3,	4264	BN	S(PJ)	V	-	-	B	B	B	B	B	B	B	B	B	-
Osprey (Pandion halietus)	SW,CG	-,-,3	4687	BNU	S(NY)	V	-	-	-	B	B	B	-	-	-	-	-	-
Prairie Falcon (Falco mexicanus)	GR,BA,SC CU,CG,SG	1,2,3	4263	BNT	R(PJ)	P	-	B	B	B	B	B	B	B	B	B	-	-
Peregrine Falcon (Falco peregrinus)	CU,SG	1,2,3	4260	NE	M	V	-	B	-	-	B	-	-	-	-	T	-	B
Merlin (Falco columbarius)	CF,CU	-,2,3	4260	BNU	M	V	-	B	-	-	T	-	-	B	-	-	-	-
American Kestrel (Falco sparverius)	GR,CU,SC, BA,CG,TL	1,2,3	2268	BN	S(PJ)	V	-	-	B	B	B	B	B	B	B	T	-	-
Sharp-tailed Grouse (Pedioecetes phasianellus)	See DNRC 1978	1,2,3	3234	BG	R(PJ)	S(P)	B	B	B	B	B	B	B	B	B	B	B	B
Sage Grouse (Centrocercus urophasianus)	SS,SG,BS, BG,SA,GR	1,2,3	1234	BG	R(PJ)	S(P)	T	-	-	B	B	B	B	B	B	T	-	-
Ring-necked Pheasant (Phasianus colchicus)	See DNRC 1978	1,2,3	1234	G	R(PJ)	S(P)	B	B	B	B	B	B	B	B	B	B	B	B
Gray Partridge (Perdix perdix)	CU,GR,LC SG,SS,BX	1,2,3	1234	G	R(RH)	S(P)	B	B	-	B	B	B	B	B	B	B	B	B
Sandhill Crane (Grus canadensis)	CU,GR	1,2,3	3230	M	M	V	-	-	-	T	-	-	-	-	B	B	T	-
Sora (Porzana carolina)	CM,SM	1,2,3	3672	M	S(TO)	V	-	-	-	-	T	B	-	-	-	-	-	-
American Coot (Fulica americana)	PR,SW,FW	1,2,3	3682	M	S(PJ)	V	-	-	-	B	T	T	T	-	-	T	-	-
Killdeer (Charadrius vociferus)	SH,GR,SA, CU,SM	1,2,3	2234	M	S(PJ)	V	-	-	B	B	B	T	B	B	T	B	-	-
Black-bellied Plover (Pluvialis squatarola)	GR	1,2,-	2230	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-

Table 1. (cont'd)

Species	Preferred Habitat	Distri- bution	Guild	Class- ifi- cation	Status	Evi- dence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Common Snipe (Capella gallinago)	FW,WM,SM	1,2,3	2234	M	S(RH)	B	-	-	-	B	-	T	-	-	-	T	-	-
Long-billed Curlew (Numenius americanus)	GR	1,2,3	2234	MU	S(RH)	V	-	-	-	-	T	T	B	-	-	-	-	-
Upland Sandpiper (Bartramia longicauda)	GR,SA	1,2,3	2234	BM	S(TO)	V	-	-	-	B	B	B	B	-	-	-	-	-
Spotted Sandpiper (Actitis macularia)	FW,PR,SH	1,2,3	2294	M	S(RH)	V	-	-	-	-	T	T	B	B	-	-	-	-
Solitary Sandpiper (Tringa solitaria)	SH,PR	1,2,-	2290	M	M	V	-	-	-	*T*	T	T	T	-	-	-	-	-
Willet (Catoptrophorus semipalmatus)	CU,WM	1,2,3	2294	M	S(TO)	V	-	-	-	B	T	T	T	-	-	-	-	-
Greater Yellowlegs (Tringa melanoleuca)	SH,PR	-,2,-	2290	M	M	V	-	-	-	-	-	*T*	T	-	*T*	-	-	-
Lesser Yellowlegs (Tringa flavipes)	SH,PR	-,2,3	2290	M	M	V	-	-	-	B	T	T	T	-	-	-	-	-
Baird's Sandpiper (Calidris bairdii)	FW,SH	1,-,-	2290	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Least Sandpiper (Calidris minutilla)	FW,SH	1,-,-	2290	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Long-billed Dowitcher (Limnodromus scalopaceus)	FW,SN	1,2,-	2290	M	M	V	-	-	-	-	T	-	T	-	-	-	-	-
Western Sandpiper (Calidris mauri)	FW,SN	1,-,-	2290	M	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Sanderling (Calidris alba)	PR	1,-,-	2290	M	M	V	-	-	-	-	-	-	S	-	-	-	-	-
Marbled Godwit *(Limosa fedoa)*	*PR*	*-,2,-*	*2290*	*M*	*M*	*V*	-	-	-	-	-	-	*T*	-	-	-	-	-
American Avocet (Recurvirostra americana)	PR,GR	1,2,3	2294	M	S(RH)	V	-	-	-	-	B	T	-	T	-	-	-	-
Wilson's Phalarope (Steganopus tricolor)	FW,PR	1,2,3	2674	N	S(RH)	V	-	-	-	-	B	B	B	-	-	-	-	-
Northern Phalarope *(Lobipes lobatus)*	*FW,PR*	*1,-,3,*	*2674*	*N*	*M*	*V*	-	-	-	-	*T*	-	-	-	-	-	-	-
California Gull (Larus californicus)	PR,FW,CU, SH	1,2,3	3230	N	V	V	-	-	-	B	-	B	B	B	-	T	-	-

Table 1. (cont'd)

Species	Preferred Habitat	Distri-bution	Guild	Class-ifi-cation	Status	Evi-dence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ring-billed Gull (Larus delawarensis)	PR,CU,GR, SH	1,2,3	3230	N	V	V	-	-	-	8	-	B	B	B	-	-	-	-
Common Tern (Sterna hirundo)	PR	1,2,-	2680	BN	V	V	-.	-	-	-	*T*	T	T	-	-	-	-	-
Black Tern (Chlidonias niger)	GR,PR	1,2,3	2682	BN	S(RH)	V	-	-	-	-	T	T	T	-	-	-	-	-
Rock Dove (Columba livia)	CU,GR,OF	-,-,3	1233	N	R(PJ)	V	T	B	B	B	B	B	B	B	B	B	B	T
Mourning Dove (Zenaida macroura)	TC,CU,GR, LC,CG	1,2,3	1236	N	S(PJ)	V	-	-	-	B	B	B	B	B	B	T	-	-
Black-billed Cuckoo (Coccyzus erythropthalmus)	SF,RS	-,-,3	2336	N	S(RH)	A	-	-	-	-	-	B	T	-	-	-	-	-
Great Horned Owl (Bubo virginianus)	FG,TC,CG BA	1,2,3	4267	N	R(PJ)	V	*T*	B	B	B	B	T	B	B	B	B	T	T
Snowy Owl (Nyctea scandiaca)	CU,GR	-,-,3	4260	N	W	V	-	8	B	-	-	-	-	-	-	-	-	T
Burrowing Owl (Speotyto cunicularia)	GR,SG	1,2,3	2269	BNU	S(PJ)	S(1)	-	-	-	B	B	B	B	B	B	-	-	-
Long-eared Owl (Asio otus)	CG	-,-,3	4267	BN	S(RH)	V	-	-	-	-	-	B	-	-	-	-	-	-
Short-eared Owl (Asio flammeus)	WM,SG,GR, CU,SR	1,2,3	4264	BN	R(PJ)	S(1)	B	T	-	B	T	T	B	B	B	T	-	-
Common Nighthawk (Chordeiles minor)	CG,GR,SS	1,2,3	2504	N	S(NE)	V	-	-	-	-	S	B	B	B	S	-	-	-
Belted Kingfisher (Megaceryle alcyon)	SM,FW	-, ,3	4683	N	S(RH)	V	-	-	-	-	B	*T*	-	-	-	-	-	-
Common Flicker (Colaptes auritus)	CF,CG,FG, SG,GR	1,2,3	2238	B	S(RH)	V	-	-	-	B	B	B	B	B	B	*T*	-	-
Red-headed Woodpecker (Melanerpes erythrocephalus)	CF,CG,GR	1,2,3	2118	BN	S(RH)	V	-	-	-	-	B	B	B	B	-	-	-	-
Hairy Woodpecker (Picoides villosus)	FG	-,2,3	2118	BN	R(SS)	V	-	B	-	-	-	T	-	-	-	-	-	-
Downy Woodpecker (Picoides pubescens)	*TC*	-,2,-	*2118*	*N*	*W*	*V*	-	*T*	-	-	-	-	-	-	-	-	-	-
Eastern Kingbird (Tyrannus tyrannus)	TC,LC,SG, GR,SR	1,2,3	2556	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-

Table 1. (cont'd)

Species	Preferred Habitat	Distribution[1]	Guild	Classification	Status	Evidence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Western Kingbird (Tyrannus verticalis)	TC,CG,FG, LC,GR	1,2,3	2557	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-
Say's Phoebe (Sayornis saya)	BA,GR	1,2,3	2553	N	S(NY)	V	-	-	-	B	B	B	B	B	-	-	-	-
Least Flycatcher (Empidonax minimus)	FG,CF,TC	-,2,3	2556	BN	S(TO)	V	-	-	-	-	B	B	T	-	-	-	-	-
Empidonax Flycatcher (Empidonax spp.)	SG,TC	1,2,-	2550	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Western Wood Pewee (Contopus sordidulus)	BX,FG	-,2,3	2557	N	S(RH)	A	-	-	-	-	T	B	-	-	-	-	-	-
Horned Lark (Eremophila alpestris)	GR,CU,SG	1,2,3	3234	N	R(NY)	S(2)	B	B	B	B	B	B	B	B	B	B	B	B
Tree Swallow (Iridoprocne bicolor)	FW,CF	-,-,3	2508	N	S(RH)	V	-	-	-	-	-	T	-	-	-	-	-	-
Bank Swallow (Riparia riparia)	GR,SA,SM	-,2,3	2503	N	S(AN)	V	-	-	-	-	-	B	B	B	-	-	-	-
Rough-winged Swallow (Stelgidopteryx ruficollis)	GR,SA,SM	-,2,3	2503	N	S(RH)	V	-	-	-	-	B	B	B	B	-	-	-	-
Barn Swallow (Hirundo rustica)	AF,OF,GR	1,2,3	2503	N	S(NY)	V	-	-	-	-	B	B	B	B	-	-	-	-
Cliff Swallow (Petrochelidon pyrrhonota)	GR,SA,AF	1,2,3	2503	N	S(NY)	V	-	-	-	-	B	B	B	B	-	-	-	-
Black-billed Magpie (Pica pica)	CF,TC,LC, CG,FG,GR	1,2,3	3236	N	R(PJ)	V	B	B	B	B	B	B	B	B	B	B	B	B
Common Crow (Corvus brachyrhynchos)	CF,GR,CU	1,2,3	3237	N	S(RH)	V	-	-	B	B	B	B	B	B	B	T	-	-
Black-capped Chickadee (Parus atricapillus)	CF,TC,RS, FG	-,2,3	2348	N	R(TO)	V	T	B	B	-	T	T	B	-	B	B	B	B
Red-breasted Nuthatch (Sitta canadensis)	FG	-,-,3	2120	N	M	V	-	-	-	-	-	-	-	-	B	-	-	-
House Wren (Troglodytes aedon)	CF,FG	-,2,3	2238	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Rock Wren (Salpinctes obsoletus)	BA,SC	1,2,3	2233	N	S(TO)	V	-	-	-	B	B	B	B	B	B	-	-	-
Gray Catbird (Dumetella carolinensis)	CF,RS	-,-,3	2336	N	S(RH)	V	-	-	-	-	B	T	B	-	-	-	-	-

Table 1. (cont'd)

Species	Preferred Habitat	Distri- bution	Guild	Class- ifi- cation	Status	Evi- dence	Monthly Occurence Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brown Thrasher (*Toxostoma rufum*)	LC,TC,GR	1,2,3	2335	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-
Sage Thrasher (*Oreoscoptes montanus*)	BS,BA	-,-,3	2335	N	S(TO)	A	-	-	-	-	T	T	B	-	-	-	-	-
American Robin (*Turdus migratorius*)	FG,LC,GR	1,2,3	3237	N	R(RH)	V	B	-	-	B	B	B	B	B	B	B	-	-
Swainson's Thrush (*Catharus ustulatus*)	BX	1,2,3	2330	N	M	A	-	-	-	-	B	-	-	-	-	-	-	-
Mountain Bluebird (*Sailia currocoides*)	GR,BA	1,2,3	2338	N	S(TO)	V	-	-	-	-	T	B	B	B	B	-	-	-
Townsend's Solitaire (*Myadestes townsendi*)	FG	-,-,3	3330	N	W	A	-	-	-	-	-	-	-	-	-	-	-	B
Golden-crowned Kinglet (*Regulus satrapa*)	TC	-,2,3	3330	BN	M	V	-	-	-	-	-	-	-	-	-	T	-	-
Water Pipit (*Motacilla spinoletta*)	SH	-,2,3	2290	N	M	V	-	-	-	B	-	-	-	-	-	-	-	-
Sprague's Pipit (*Anthus spragueii*)	SG,SG	1,2,3	2234	N	S(TO)	V	-	-	-	B	B	B	B	B	-	-	-	-
Bohemian Waxwing (*Bombycilla garrulus*)	CF,RS,CU	-,-,3	1440	N	W	V	B	B	B	-	-	-	-	-	-	-	B	B
Cedar Waxwing (*Bombycilla cedrorum*)	CF,RS,FG	-,-,3	3447	N	S(RH)	V	-	-	-	-	-	-	T	-	B	-	-	-
Northern Shrike (*Lanius excubitor*)	TC,GR,SG	-,2,3	4260	N	W	S(1)	B	B	-	-	-	-	-	-	-	B	B	B
Loggerhead Shrike (*Lanius ludovicianus*)	TC,LC,GR, SG	1,2,3	4226	BN	S(PJ)	S(1)	-	-	-	B	B	B	B	B	-	-	-	-
Starling (*Sturnus vulgaris*)	OF,AF,FG, CG	1,2,3	3233	N	R(NY)	V	T	-	B	B	B	B	B	B	B	B	B	B
Red-eyed Vireo (*Vireo olivaceus*)	CF	-,-,3	2447	N	S(RM)	A	-	-	-	-	-	-	T	-	-	-	-	-
Warbling Vireo (*Vireo gilvus*)	CG,FG,CF	-,2,3	2447	BN	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Tennessee Warbler (*Vermivora peregrina*)	BX,FG	-,-,3	2440	N	M	S(1)	-	-	-	-	T	-	-	-	-	-	-	-
Orange-crowned Warbler (*Vermivora celata*)	BX	-,-,3	2440	N	M	V	-	-	-	B	-	-	-	-	-	-	-	-

Table 1. (cont'd)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Yellow Warbler (*Dendroica petechia*)	LC,TC,SR, FG,CF,CG	1,2,3	2336	BN	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Magnolia Warbler (*Dendroica magnilia*)	FG	-,-,3	2330	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Yellow-rumped Warbler (*Dendroica coronata*)	TC,LC,SR, SS	-,2,3	3230	N	M	V	-	-	-	B	T	-	-	-	B	T	-	-
Blackpoll Warbler (*Dendroica coronata*)	PW,CG,RC	-,2,3	2330	N	M	P	-	-	-	-	T	-	-	-	-	-	-	-
Northern Waterthrush (*Seiurus noveboracensis*)	PW,CG	-,2,-	2230	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
Common Yellowthroat (*Geothlypis trichas*)	SR,SS,LC	1,2,3	2334	N	S(AF)	V	-	-	-	-	B	B	B	B	-	-	-	-
Yellow-breasted Chat (*Icteria virens*)	TC	1,2,3	2336	BN	S(TO)	V	-	-	-	-	T	B	B	B	-	-	-	-
American Redstart (*Setophaga ruticilla*)	CG,BX	-,2,3	2447	N	S(RH)	V	-	-	-	-	T	-	-	-	-	-	-	-
Wilson's Warbler (*Wilsonia pusilla*)	RS,TC	-,2,3	3230	N	M	V	-	-	-	-	-	-	-	-	B	T	-	-
House Sparrow (*Passer domesticus*)	OF,AF,FG	1,2,3	3233	N	R(PJ)	V	B	B	B	B	B	B	B	B	B	B	B	B
Boblink (*Dolichonyx oryzivorus*)	CU	1,2,3	3234	N	S(AF)	V	-	-	-	-	B	T	T	-	-	-	B	-
Western Meadowlark (*Sturnella neglecta*)	GR,SS,SG, CU,LC,SR	1,2,3	2234	N	S(NY)	V	-	-	T	B	B	B	B	B	B	B	T	-
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)	SM,GR	1,2,3	2231	N	S(TO)	V	-	-	-	B	B	B	B	B	-	T	-	-
Red-winged Blackbird (*Agelaius phoeniceus*)	CM,SM,GR	1,2,3	2231	N	R(NY)	V	-	B	T	B	B	B	B	B	B	B	T	-
Orchard Oriole (*Icterus spurius*)	BX,CF	-,2,3	2447	N	S(TO)	V	-	-	-	-	B	T	-	-	-	-	-	-
Northern Oriole (*Ictarus galbula*)	CF,CG,BX, SS	1,2,3	2447	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Brewer's Blackbird (*Euphaga cyanocephalus*)	GR,CU,BA, TC	1,2,3,	2234	N	S(PJ)	s(1)	-	-	-	B	B	B	B	B	T	B	T	-
Common Grackle (*Quiscalus quiscula*)	GR,CG	1,2,3	2236	N	S(RH)	V	-	-	-	B	B	B	B	-	-	-	-	-

Table 1. (cont'd)

Species	Preferred Habitat	Distribution	Guild	Classification	Status	Evidence	Monthly Occurence Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brown-headed Cowbird (*Molothrus ater*)	GR,LC,TC	1,2,3	223-	N	S(NE)	V	-	-	-	-	B	B	B	-	-	-	B	-
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)	LC,TC	1,-,-	3330	N	M	V	-	-	-	-	-	-	-	-	-	T	-	-
Black-headed Grosbeak (*Pheucticus melanocephalus*)	TC	-,2,-	3330	N	V	V	-	-	-	-	T	-	-	-	-	-	-	-
Lazuli Bunting (*Passerina amoena*)	RS,CU	-,-,3	3236	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Gray-crowned Rosy Finch (*Leucosticte tephrocotis*)	LC	1,-,-	1230	N	M	V	-	-	-	-	-	-	B	-	-	-	-	-
Common Redpoll (*Acanthis flammea*)	CU,GR,TC	1,2,3	1230	N	W	V	B	B	B	-	-	-	-	-	-	B	B	B
American Goldfinch (*Spinus tristis*)	FG,TC,RS, CG,LC,GR	1,2,3	1236	N	S(RH)	V	-	-	-	-	B	B	B	B	B	-	-	-
Rufous-sided Towhee (*Pipilo erythrophthalmus*)	TC,LC	1,2,3	3235	N	S(PJ)	V	-	-	-	-	B	B	B	B	B	-	-	-
Lark Bunting (*Calamospiza melanocorys*)	SS,SG,GR	1,2,3	3234	N	S(PJ)	V	-	-	B	-	B	B	B	B	-	-	B	-
Savannah Sparrow (*Passerculus sandwichensis*)	GR,SS,WM	1,2,3	3234	N	S(TO)	V	-	-	-	-	B	B	B	-	B	-	-	-
Grasshopper Sparrow (*Ammodramus savannarum*)	SG,GR	1,2,3	3234	BN	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-
Baird's Sparrow (*Ammodramus bairdii*)	GR,SA	1,2,3	3234	N	S(TO)	V	-	-	-	-	T	T	T	-	-	-	-	-
Vesper Sparrow (*Pooecetes gramineus*)	SS,SG,GR BS,BG	1,2,3	3234	BN	S(TO)	S(1)	-	-	-	B	B	B	B	B	B	-	-	-
Lark Sparrow (*Chondestes grammacus*)	GR,BA,SG	1,2,3	3234	N	S(PJ)	V	-	-	-	-	B	B	B	B	-	-	-	-
Dark-eyed Junco (*Junco hyemalis*)	TC,SG,BA	1,2,3	3230	N	M	V	-	-	-	-	-	-	-	-	B	T	-	-
Tree Sparrow (*Spizella arborea*)	TC,RS,SR, WI	1,2,3	1230	N	W	V	-	T	B	-	-	-	-	-	-	B	T	-
Chipping Sparrow (*Spizella passerina*)	SS,SG,TC, RS	1,2,3	3236	N	S(RH)	V	-	-	-	-	B	T	B	B	B	-	-	-
Clay-colored Sparrow (*Spizella pallida*)	SR,RS	1,2,3	3234	N	S(TO)	V	-	-	-	-	B	B	B	-	-	-	-	-

Table 1. (cont'd)

Species	Preferred Habitat	Distri-bution	Guild	Class-ifi-cation	Status	Evi-dence	Monthly Occurence											
							Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Brewer's Sparrow (Spizella breweri)	SS,SG,BS, BG	1,2,3	2235	N	S(NY)	V	-	-	-	B	B	B	B	B	-	-	-	-
Field Sparrow (Spizella pusilla)	GR,SG	1,-,3	3234	N	S(TO)	V	-	-	-	-	B	B	B	B	-	-	-	-
Harris' Sparrow (Zonotrichia querula)	FG	-,-,3	3230	N	M	V	-	-	-	-	T	-	-	-	-	-	-	-
White-crowned Sparrow (Zonotrichia leucophrys)	TC,RS,CF	-,-,3	1230	N	M	V	-	-	-	B	B	-	-	-	B	-	-	-
Song Sparrow (Melospiza melodia)	CF,CG,RS, FG	-,-,3	3334	N	S(RH)	V	-	-	-	B	T	T	-	B	-	-	-	-
McCown's Longspur (Calcarius mccownii)	GR	-,-,3	3234	N	S(TO)	V	-	-	-	-	B	B	B	B	-	-	-	-
Lapland Longspur (Calcarius lapponicus)	CU,GR	-,2,3	1230	N	W	V	B	B	T	-	-	-	-	-	-	-	B	B
Chestnut-collared Longspur (Calcarius ornatus)	GR,CU	1,2,3	3234	N	S(NE)	S(1)	-	-	-	B	B	B	B	B	B	T	-	-
Snow Bunting (Plectrophenax nivalis)	CU,GR	1,2,3	1230	N	W	V	B	B	T	-	-	-	-	-	-	B	B	B

Table 2. Summary of inventory data for amphibian, reptile, and mammal species observed in the Circle West study area, June 1976 - February 1981. (see text for explanation of abbreviations)

Species	Preferred Habitat	Distri-bution	Major Food Sources	Class-ification	Evi-dence	Monthly Occurence											
						Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
AMPHIBIANS																	
Tiger Salamander (Ambystoma tigrinum)	RD,AF	-,2,-	Worms, slugs, insects	N	P	-	-	-	-	-	-	B	-	-	-	-	-
Woodhouse's Toad (Bufo woodhousei)	SC,GR	1,-,-	Insects	N	S(1)	-	-	-	-	T	-	T	-	-	-	-	-
Great Plains Toad (Bufo cognatus)	SR,GR	-,2,-	Insects	N	S(1)	-	-	-	-	T	B	-	-	-	-	-	-
Leopard Frog (Rana pipiens)	SM,PG	1,2,3	Insects	N	S(1)	-	-	-	B	B	B	B	T	-	-	-	-
Boreal Chorus Frog (Pseudacris triseriata)	PG	1,2,3	Insects	N	S(1)	-	-	-	B	B	B	B	-	-	-	-	-
REPTILES																	
Painted Turtle (Chrysemys picta)	PG,PM SM,RD	1,2,3	Aquatic plants & invertebrates	N	V	-	-	-	B	B	B	B	B	-	-	-	-
Short-horned Lizard (Phrynosoma douglassi)	BA	1,2,-	Insects	N	S(1)	-	-	-	-	-	B	-	-	-	-	-	-
Western Hognose Snake (Heterodon nasicus)	GR	-,2,-	Rodents, frogs, young birds, insects	N	P	-	-	-	-	-	B	-	-	-	-	-	-
Racer (Coluber constrictor)	GR	1,2,3	Rodents, frogs, young birds, insects	N	S(1)	-	-	-	-	B	B	B	-	-	-	-	-
Gopher Snake (Pituophis catenifer)	SA,BA AF,DF	1,2,3	Rodents, rabbits birds, eggs	N	P	-	-	-	-	B	B	B	-	-	-	-	-
Plains Garter Snake (Thamnophis radix)	SM,PR	1,2,3	Frogs, insects, mice, earthworms	N	V	-	-	-	-	B	B	-	-	-	-	-	-
Prairie Rattlesnake (Crotalus viridis)	GR,SG,SS	1,2,3	Rodents, frogs, Birds	N	S(1)	-	-	-	-	B	B	B	-	T	T	-	-
MAMMALS																	
Masked Shrew (Sorex cinereus)	*SM,TC*	*1,-,-*	*Invertebrates*	*N*	*S(2)*	-	-	-	-	*T*	-	-	-	-	*T*	-	-

Table 2. (cont'd)

Species	Preferred Habitat	Distri-bution	Major Food Sources	Class-ifi-cation	Evi-dence	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
						Monthly Occurence											
Merriam's Shrew (*Sorex merriami*)	HJ	1,-,-	Invertebrates	N	S(1)	-	-	-	-	-	-	-	-	-	B	-	-
Desert Cottontail (*Sylvilagus audoboni*)	LC,TC,SS, SG,AF	1,2,3	Grass, seeds, leaves, fruit	N	S(3)	B	B	-	B	B	B	B	B	B	B	B	B
White-tailed Jackrabbit (*Lepus townsendi*)	GR,SS,SG	1,2,3	Grasses, forbs buds, twigs	N	P	B	B	-	B	B	B	B	B	B	B	B	B
Least Chipmunk (*Eutamias minimus*)	TC,LC,BA	1,2,3	Plants, seeds, fruits, insects	N	S(1)	-	-	-	-	T	B	B	B	B	B	-	-
13-lined Ground Squirrel (*Spermophilus tridecemlineatus*)	GR	1,2,3	Grass, seeds, insects	N	V	-	-	-	B	B	B	B	B	B	B	-	-
Black-tailed Prairie Dog (*Cynomys ludovicianus*)	GR	-,2,3	Grasses, insects	N	S(2)	-	-	B	B	B	B	B	B	B	B	B	-
Northern Pocket Gopher (*Thomomys talpoides*)	GR,WM	1,2,3	Roots, grasses	N	S(1)	-	-	-	-	-	-	T	-	-	-	-	-
Wyoming Pocket Mouse (*Perognathus fasciatus*)	GR,SS	1,2,3	Seeds, grass	N	V	-	-	-	-	T	-	-	-	-	T	-	-
Beaver (*Castor canadensis*)	FW	1,2,3	Bark and twigs, green plants	F	R	-	-	-	-	T	T	-	-	-	-	-	-
Western Harvest Mouse (*Reithrodontomys megalotis*)	SC,GR,LS	1,2,3	Seeds, grass	N	S(2)	-	-	-	-	T	-	-	-	-	T	-	-
Deer Mouse (*Peromyscus maniculatus*)	Various	1,2,3	Seeds, grass insects, fruits	N	S(12)	-	-	-	B	-	B	B	B	B	B	-	-
Prairie Vole (*Microtus ochrogaster*)	SR	1,2,-	Grasses, seeds, insects	N	S(6)	-	-	-	-	T	-	-	-	-	T	-	-
Meadow Vole (*Microtus pennsylvanicus*)	SM	1,2,-	Grasses, seeds, insects	N	S(1)	-	-	-	-	T	-	-	-	-	T	-	-
Long-tailed Vole (*Microtus longicaudus*)	TC	1,2,-	Grasses, seeds, insects	N	S(1)	-	-	-	-	-	-	-	-	-	T	-	-
Muskrat (*Ondatra zibethicus*)	FW,SA	1,2,3	Aquatic plants and animals	F	V	-	-	B	B	B	B	B	B	B	B	B	-
Porcupine (*Erethizon dorsatum*)	CG,CF,TC, LC	1,2,3	Bark, buds, twigs, forbs	N	S(1)	T	B	B	-	T	B	B	B	B	B	B	B
Coyote (*Canis latrans*)	Various	1,2,3	Mice, rabbits, carrion, insects	P	S(1)	T	T	B	B	B	B	B	B	B	B	B	B
Red Fox (*Vulpes fulva*)	Various	1,2,3	Mice, rabbits, insects, fruit	N	V	T	B	B	T	-	B	B	B	B	B	B	B

Table 2. (cont'd)

Species	Preferred Habitat	Distri- bution	Major Food Sources	Class- ifi- cation	Evi- dence	Monthly Occurence											
						Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Racoon (Procyon lotor)	CF,BX,CU	-,2,3	Various	N	V	T	-	-	B	B	B	B	B	B	T	-	-
Long-tailed Weasel (Mustela frenata)	RD	1,2,3	Small rodents, birds	P	P	T	T	B	-	-	-	T	-	-	T	-	-
Mink (Mustela vison)	FW	-,2,3	Fish, small mammals, birds	F	R	-	-	-	-	-	-	-	-	-	T	-	-
Badger (Taxidea taxus)	GR	1,2,3	Rodents, rabbits	N	V	-	-	-	B	-	-	B	T	B	-	-	-
Striped Skunk (Mephitis mephitis)	Various	1,2,3	Insects, fruit, eggs, carion	P	V	-	-	B	B	B	B	B	B	B	B	-	T
Bobcat (Lynx rufus)	BA	1,2,-	Rabbits, rodents, birds	F	V	-	-	-	-	-	-	-	B	-	-	-	-
Mule Deer (Odocoileus hemionus)	See DNRC (1978)	1,2,3 See text	See DNRC (1978)	G	V	B	B	B	B	B	B	B	B	B	B	B	B
White-tailed Deer (Odocoileus virginianus)	See DNRC (1978)	1,2,3 See text	See DNRC (1978)	G	V	B	B	B	B	B	B	B	B	B	B	B	B
Pronghorn Antelope (Antilocarpra americana)	See DNRC (1978)	1,2,3 See text	See DNRC (1978)	G	V	B	B	B	B	B	B	B	B	B	B	B	B

foliage foraging; 5, sallying; 6, raptorial; 7, dabbling or stalking in water; 8, diving in water; 9, mud probing; 0, soaring or swooping. The fourth digit indicates preferred nest site: 1 indicates cattails or bulrush; 2, shore, marsh, or water; 3, cliffs, caves, rims, badlands, buildings; 4, ground, grassland; 5, low shrub (less than 1 m or 3 ft); 6, tall shrub (1 m - 3 m or 3 ft-10 ft); 7, tree branch (greater than 3 m or 10 ft); 8, tree cavity; 9, underground burrow; 0, nonbreeding in study area.

Status (Birds Only). First letter denotes indicated status in the study area: M indicates spring and fall migrant only; R, permanent resident; S, summer resident; V, summer visitor (nonbreeding); W, winter resident. For permanent and summer residents, evidence for breeding is given in parentheses using a modification of Binford's (1973) categories, which are, in order of decreasing conclusiveness: PJ indicates prejuvenal young observed; NY, nest with young; NE, nest with eggs; AN, active nest completed, contents unknown; NC, active nest completed but empty; UC, nest under construction; UN, active nest, condition unknown; AF, adult carrying food; AC, adult carrying nest material; CO, copulation observed; CD, courtship display observed; TO, territoriality observed; RH, range, habitat, and dates; SS, observed in area outside breeding season (for sedentary or permanent resident species only). Only the most conclusive evidence obtained during this study is listed in the table.

Monthly Occurrence. The letter "B" indicates observations made during the baseline study period (DNRC 1978); the letter "T" indicates observations made during other years.

Table 3 summarizes the cumulative numbers of species observed in the study areas during the baseline study and through the first, second, and third monitoring periods. This table shows that six new vertebrate species were added to the species list as a result of the third year's monitoring; these are the black-crowned night heron, cinnamon teal, marbled godwit, northern phalarope, downy woodpecker, and masked shrew.

Narrative Accounts for Selected Species

Data in addition to that in Tables 1 and 2 were obtained for certain key species, and are summarized in the following species accounts. Information presented here, limited for the most part to nesting raptors, upland game birds, and ungulates, primarily assesses changes that have occurred in the Mine Study Area since the baseline study. Additional data on all 209 species are on file with DNRC.

Red-tailed Hawk. The nest found on the Proposed Mining Area in 1977 was inactive in 1980. The nest found in 1977 in the southwestern corner of the Mine Study Area produced at least 1 young in 1980, and the nest near stockpond MC10 contained at least 2 young. A new nest in a cottonwood about 2.5 mi WSW of the Dreyer ranch contained at least 2 young.

Swainson's Hawk. Swainson's hawks seemed to be less common in 1980 than in 1979. Of the two active nests found in the Mine Study Area in 1979, only one (in the original Proposed Mining Area) was active in 1980; it produced 2 young.

Ferruginous Hawk. Three ferruginous hawk nests were active in 1980. One was near the 1979 nest site about 2 mi NNW of the Dreyer ranch house and contained 2 young on June 13, 1980. Another was near the 1977 nest site about 2 mi NW of the Waller ranch house and fledged 2 young. A third was just off the

Table 3. Summary of cumulative numbers of species observed in the Circle West study areas through February 28, 1981.

	Baseline Study (through February 28, 1978)			Through First Monitoring Period (March 7, 1979)			Through Second Monitoring Period (Feb. 29, 1980)			Through Third Monitoring Period (Feb. 28, 1981)		
	PMA	MSA	REC[1]	PMA	MSA	REC	PA	MSA	REC	PA	MSA	REC
AMPHIBIANS												
Total number of Species	2	4	4	4	5	5	4	5	5	4	5	5
REPTILES												
Total number of Species	6	7	7	6	7	7	6	7	7	6	7	7
BIRDS												
Total number of Species (T)	79	109	139	101	132	160	109	141	164	115	149	169
Summer Residents (S)	56	68	85	66	75	92	69	80	93	73	83	94
Permanent Residents (R)	12	16	17	13	16	17	14	16	17	14	17	18
Non-breeding Summer Visitors (V)	2	2	3	3	5	5	3	5	5	4	6	6
Migrants (M)	6	16	24	15	29	36	18	33	39	19	36	41
Winter Residents (W)	4	7	10	4	7	10	5	7	10	5	7	10
Total Breeding Species (S&R)	68	84	102	79	91	109	83	96	110	87	100	112
MAMMALS												
Total number of Species	19	26	26	20	27	27	24	27	27	25	28	28
TOTAL VERTEBRATE SPECIES	106	146	176	131	171	199	143	180	203	150	189	209

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[1] PMA=Proposed Mining Area; PA=Permit Area; MSA=Mine Study Area (now 113 sections, including PA); REC=Reconnaissance Study Area (including MSA)

southeastern corner of the Mine Study Area and contained 2 young on June 12. A nest about 4 mi WSW of the Dreyer ranch house, which was active in 1979, was unoccupied in 1980.

Golden Eagle. The nest located in 1977 in the Proposed Mining Area fledged 2 young in 1980. A new nest site, located in the extreme northwestern corner of the Mine Study Area, also fledged 2 young in 1980.

Marsh Hawk. Although territorial pairs were observed in the Mine Study Area, no nests were discovered.

Prairie Falcon. The 1977 nest site contained 4 young on June 14, 1980.

American Kestrel. No active Kestrel nests were found in 1980.

Sharp-tailed Grouse. At least 22 male birds were displaying at lek No. 6 when visited in March 1980; 36 unclassified adults were seen nearby on another day. Two birds were seen at lek No. 3 in April 1980, and 12 birds were seen at lek No. 14 in March 1980. No activity was observed at leks No. 7 and No. 13, although birds were seen on several occasions near these leks.

Sage Grouse. Groups of 2-4 sage grouse were seen between March-May 1980 near: the old homestead site (area Y); section 9, area Z; the Waller ranch house; and 2 mi NE of the Waller ranch house. No courtship activity was observed, however, and no grouse were seen at lek No. 4 (DNRC 1978) when it was visited in March.

Ring-necked Pheasant. Figure 3 shows year-to-year changes in June sample abundances of ring-necked pheasants as sampled in five roadside wildlife surveys. Sample abundances did not differ significantly (t-test, $p > .20$) between 1979 and 1980.

Great Horned Owl. Great horned owls seemed to be less common in 1980 than in 1979. None of the previously used nest sites were active in 1980.

Desert Cottontail. Results of the 1980 lagomorph survey are presented in Table 4. As in 1979, no cottontails were observed during this survey (Figure 4).

White-tailed Jackrabbit. The number of jackrabbits observed during the 1980 lagomorph survey (Table 4) does not differ significantly from the number observed in 1979 (t-test, $p > .20$)(Figure 4).

Mule Deer. A summary of mule deer observations during the study period is presented in Table 5. Production ratios obtained during the period 1977-1980 are shown in Figure 5. These were based on September-October data since summer foliage limits pre-September observations of fawns and since hunting mortality directly influences age structure in November populations. The 1980 production ratio was 76 fawns/100 does, which is considerably lower than 1979 production.

Aerial census data are presented in Table 6. It should be emphasized that the low numbers of deer observed during the summer reflect decreased observability at this season and do not necessarily indicate a corresponding decrease in abundance. Since observability is highest in winter, both density and distribution estimates are based on the winter aerial census. Figure 6 shows winter density indices obtained since 1976. Since the census data in

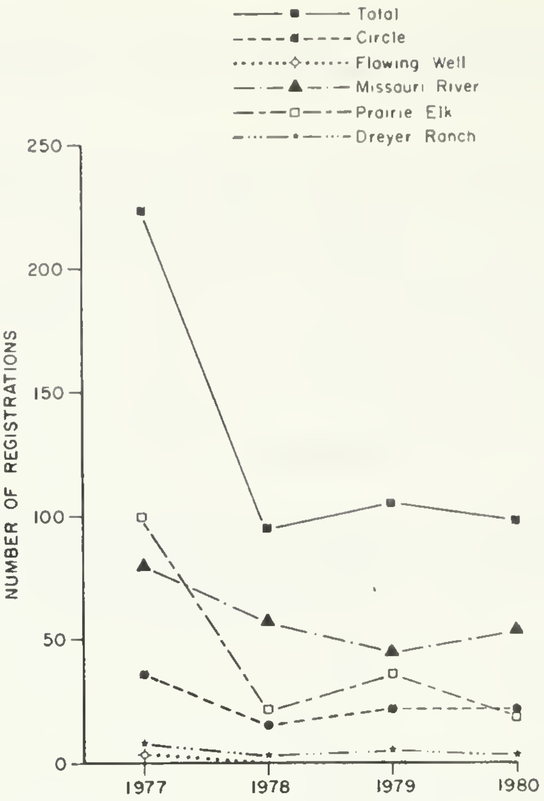

Figure 3. Year-to-year changes in June sample abundance of ring-necked pheasant along five roadside wildlife survey routes, Circle West area.

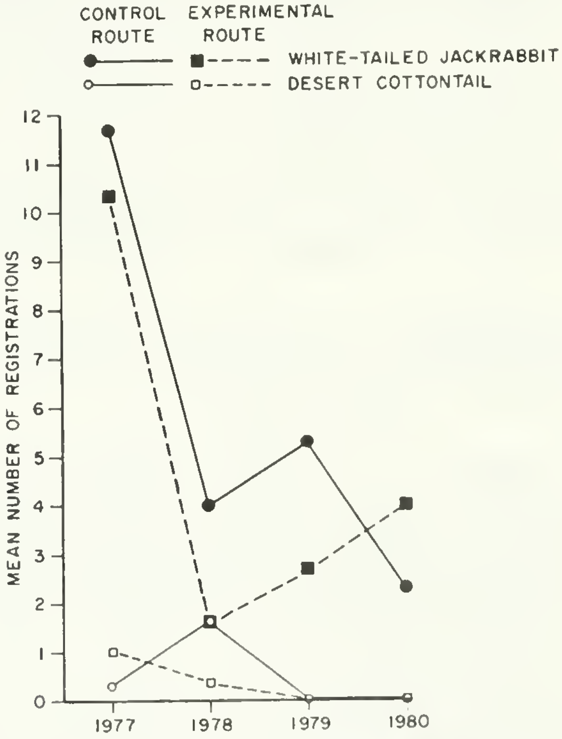

Figure 4. Year-to-year changes in lagomorph density indices, Circle West study area.

Table 4. Results of 1980 lagomorph survey, Circle West study area.

Date	Desert Cottontail		White-tailed Jackrabbit	
	Control Route	Experimental Route	Control Route	Experimental Route
October 30, 1980	0	0	4	6
November 1, 1980	0	0	2	3
November 2, 1980	0	0	1	3
Mean	0.0	0.0	2.3	4.0

Table 5. Classification summary for mule deer observed in the Circle West area, March 1980 - February 1981.

	All Groups				Fully Classified Groups Only							
		Group Size										
Period	Number of Groups	Average	Range	Total No. Observed	Total No. Classified	Total Adults	Adult Males	Adult Females	Young	Young/ 100 Adults	Young/ 100 Females	Males/ Females
Spring 1980	92	6	1-37	518	18	14	0	14	4	-	-	-
Summer 1980	63	3	1-10	164	94	61	6	55	33	-	-	-
Fall 1980	127	5	1-30	583	465	288	44	244	177	61.5	72.5	0.18
Winter 1980-81	95	6	1-42	548	117	74	0	74	43	-	-	-

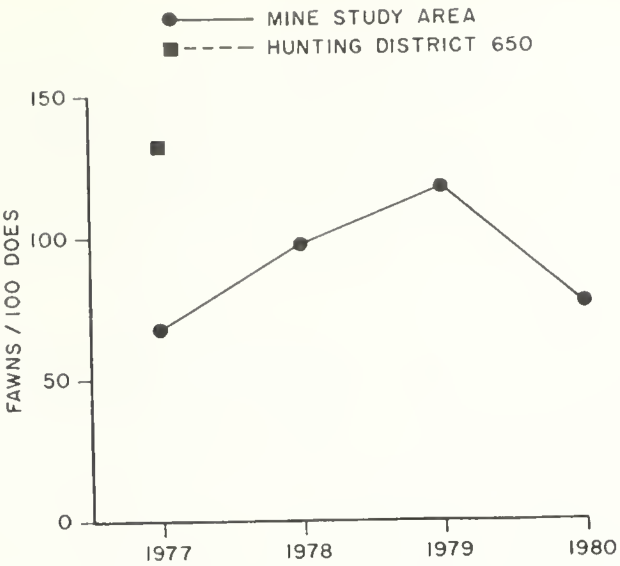

Figure 5. Year-to-year changes in mule deer production ratios, Circle West study areas (based on September-October ground and aerial survey data).

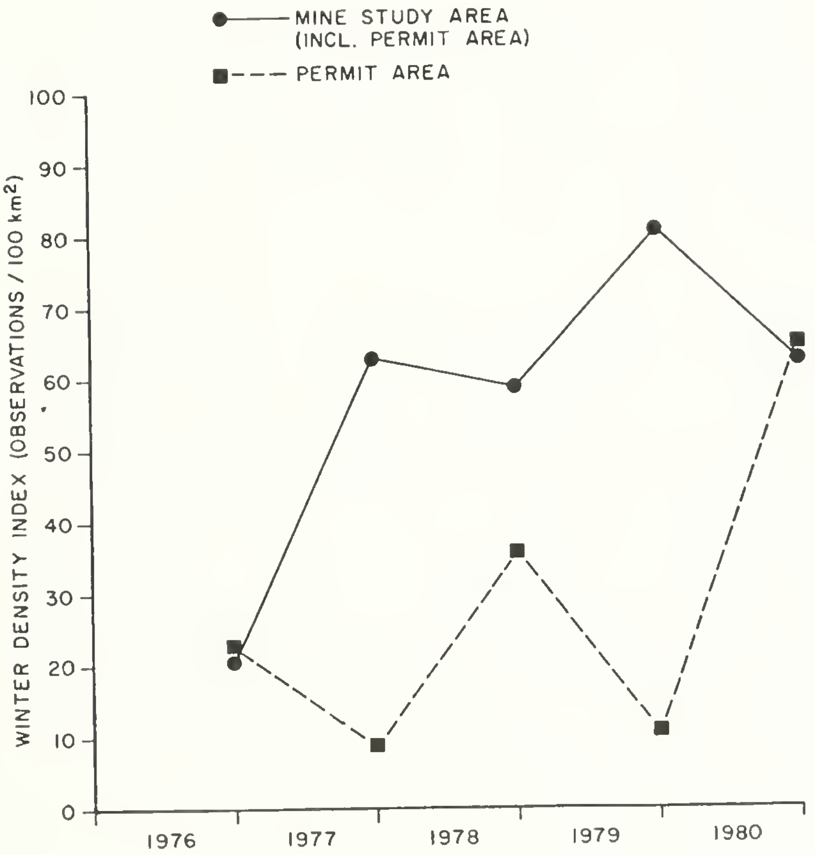

Figure 6. Year-to-year changes in the mule deer winter density index for the Circle West study areas (based on the month of the largest census obtained for the mine study area during the winter season).

Table 6 represent the minimum number known to be present (i.e., 186 mule deer were observed during the February flight, although there may have been more that were not seen), the density indices shown in Figure 6 may be somewhat lower than true densities. The data indicate a decrease in mule deer winter density in the Mine Study Area since the last monitoring period; the Permit Area, however, showed an increase. Densities were similar for the control area and the Permit Area.

Monthly mule deer winter density indices obtained during aerial censuses were averaged for each of the 114 sections in the Mine Study Area for the winter of 1980-1981 and for all winters since 1976. These data were used to create density index isopleths that show general patterns of winter distribution (Figures 7 and 8). Both figures show that deer tend to concentrate in areas of coulee and badlands topography in the northwestern, southwestern, and southeastern portions of the Mine Study Area, as well as near the Waller ranch. (Since, for mapping purposes, deer were assumed to be concentrated in the center of each section, distribution as indicated by the isopleths is only accurate to within about 1 kilometer.)

White-tailed Deer. Use of the Mine Study Area by white-tailed deer increased markedly in 1980; 114 observations were recorded during the monitoring period (Table 7), compared to only 28 in 1979. Much of this increase was due to incorporating sections 21-24, which were used in fall and winter by groups of up to 8 white-tailed deer, into the northeastern corner of the expanded Mine Study Area. Two other important use areas were identified in the Mine Study Area. Sections 29-32 just west of the Dreyer ranch house were used extensively by groups of up to 8 deer. Although this area was used during all seasons, use was heaviest in the fall of 1980. Groups of up to 3 deer were observed near the sagebrush bird census plot close to the southwestern edge of the original Proposed Mining Area (area X) in the spring, summer, and fall. Additional observations were made near stockpond MA01 about 2 miles SSE of the Dreyer ranch house.

Pronghorn. A summary of pronghorn observations made during the study period is presented in Table 8. Production ratios for the Mine Study Area from 1977-1979 (based on all July through October observations of fully classified groups) are shown in Figure 9. A production ratio of 64 fawns/100 does was obtained in 1980; this is the lowest ratio obtained since the study began in 1977. (NOTE: 1979 production was 107 fawns/100 does, not 197/100 as reported on p. 33 of the second annual report.) In contrast, the 1980 production ratio in DFWP Hunting District 650 was 101 fawns/100 does (Table 9). Results of the July 1980 pronghorn aerial census of Hunting District 650 are presented in Table 9. Aerial census data for the Mine Study Area are presented in Table 6. Winter density indices (as described under Mule Deer, above) and summer-fall density indices (based on the largest aerial census figures obtained during a single flight in the period from July-October) are shown in Figure 10 for 1977-1980. These data indicate an increase in summer-fall pronghorn density in the Mine Study Area since 1979, although densities in the Permit Area showed a decrease. Winter density in the Mine Study Area increased markedly since the last monitoring period due to mild winter conditions and lack of snow cover. In fact, winter 1980 densities were the highest obtained since the study began in 1976.

Monthly pronghorn summer and winter density indices obtained during aerial censuses were averaged for each section in the Mine Study Area for the report period as well as for all years since 1976 combined. These data were used to

Table 6. Deer and pronghorn aerial census data, Circle West area, March 1980 - February 1981.

Date	Observer	Mine Study Area [1]			Proposed Mining Area [2]			Permit Area [3]		
		Pronghorn	Mule Deer	White-tailed Deer	Pronghorn	Mule Deer	White-tailed Deer	Pronghorn	Mule Deer	White-tailed Deer
Mar. 7, 1980	Stoneberg	133	139	0	0	12	0	0	38	0
Apr. 21, 1980	"	118	136	0	0	19	0	7	27	0
May 13, 1980	"	108	51	0	0	0	0	7	6	0
June 13, 1980	"	96	77	4	0	3	0	3	6	0
July 9-11, 1980[4]	"	159	N.C.[5]	N.C.	2	N.C.	N.C.	31	N.C.	N.C.
Sept. 23, 1980	"	140	91	16	9	1	0	20	35	8
Oct. 10, 1980	"	173	151	17	11	0	0	11	28	2
Nov. 24, 1980	"	210	80	16	0	0	0	0	6	0
Dec. 8, 1980	"	155	127	13	0	8	0	4	29	0
Feb. 3, 1981	"	72	186	0	3	19	0	3	51	0
Feb. 13 - Mar. 5, 1981[4]	"	74	110	3	0	8	0	5	20	0

[1] 293 km^2 (113 mi^2); includes permit area and proposed mining area

[2] 30 km^2 (11.5 mi^2)

[3] 78 km^2 (31.5 mi^2)

[4] Censuses conducted during survey of Hunting District 650

[5] No counts of deer made during this census

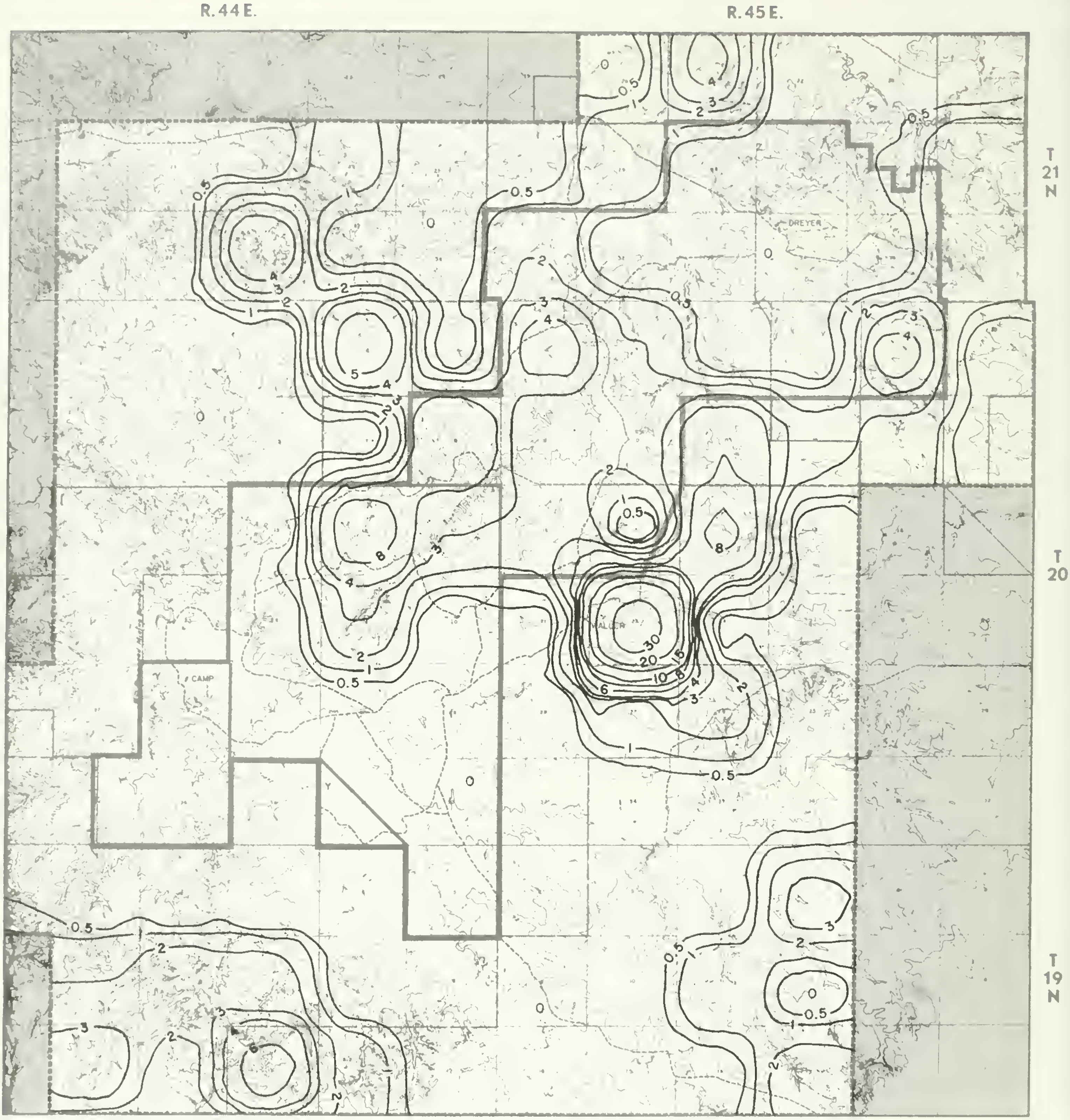

FIGURE 7. MULE DEER WINTER DENSITY INDEX ISOPLETHS, 1980-81

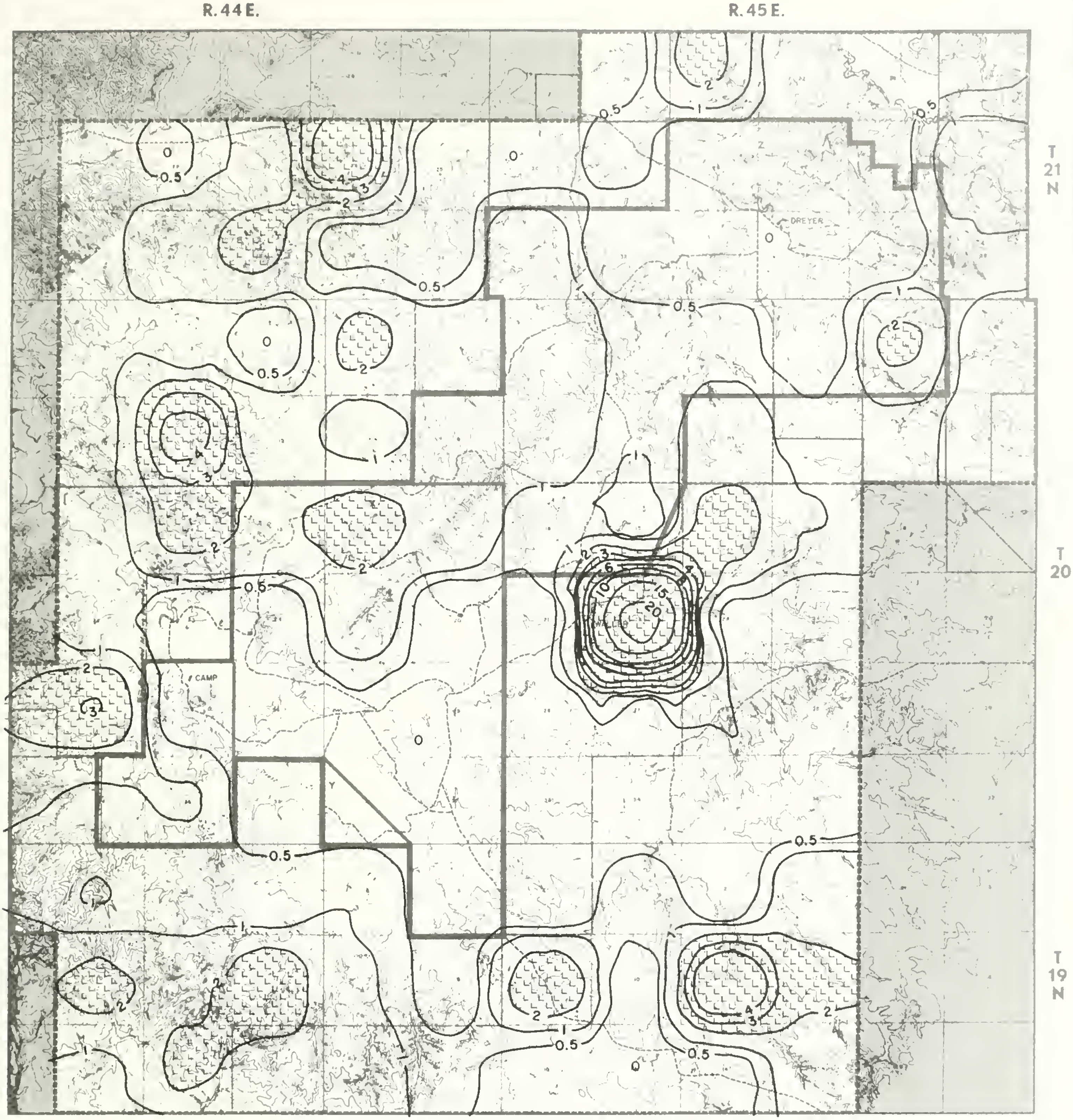

FIGURE 8. MULE DEER WINTER DENSITY INDEX ISOPLETHS, FIVE-YEAR AVERAGE, 1976-81

(NOTE: Areas with a winter density index greater than 2.0 are cross hatched.)

Table 7. Classification summary for white-tailed deer observed in the Circle West area, March 1980 - February 1981.

	All Groups				Classified Groups Only			
Period	Number of Groups	Group Size Average	Group Size Range	Total No. Observed	Total Number Classified	Adult Males	Adult Females	Young
Spring 1980	7	2.0	1-3	14	6	-	-	-
Summer 1980	7	1.7	1-2	12	10	-	-	-
Fall 1980	29	2.4	1-8	71	66	14	26	26
Winter 1980-81	4	4.3	1-8	17	13	-	-	-

Table 8. Classification summary for pronghorn observed in the Circle West areas, March 1980 - February 1981.

Period	All Groups				Fully Classified Groups Only							
	Number of Groups	Group Size		Total No. Observed	Total No. Classified	Total Adults	Adult Males	Adult Females	Young	Young/ 100 Adults	Young/ 100 Females	Males/ Females
		Average	Range									
Spring 1980	75	8	1-44	565	20	19	11	8	1	-	-	-
Summer 1980	61	4	1-16	234	195	160	84	76	35	21.9	46.0	1.10
Fall 1980	83	9	1-51	768	270	202	69	133	68	33.7	51.1	0.52
Winter 18-81	24	16	1-75	386	27	27	10	17	0	-	-	-

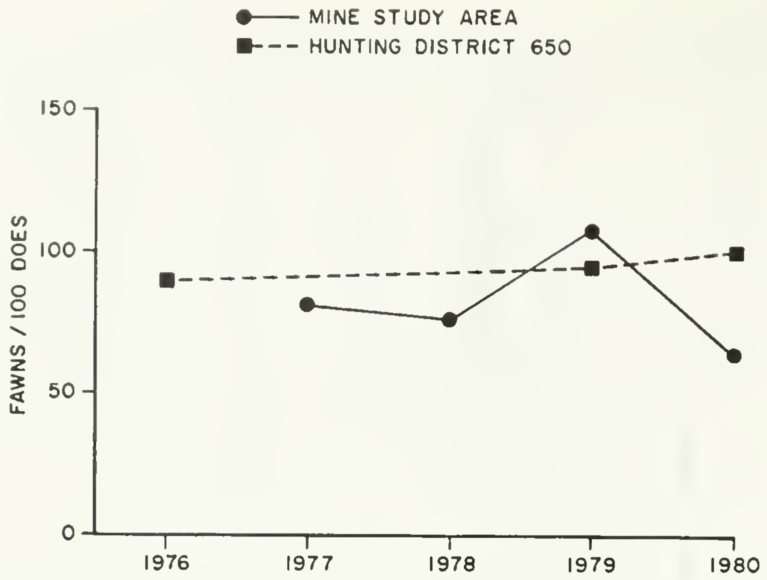

Figure 9. Year-to-year changes in pronghorn production ratios, Circle West study areas (based on July-October ground and aerial survey data).

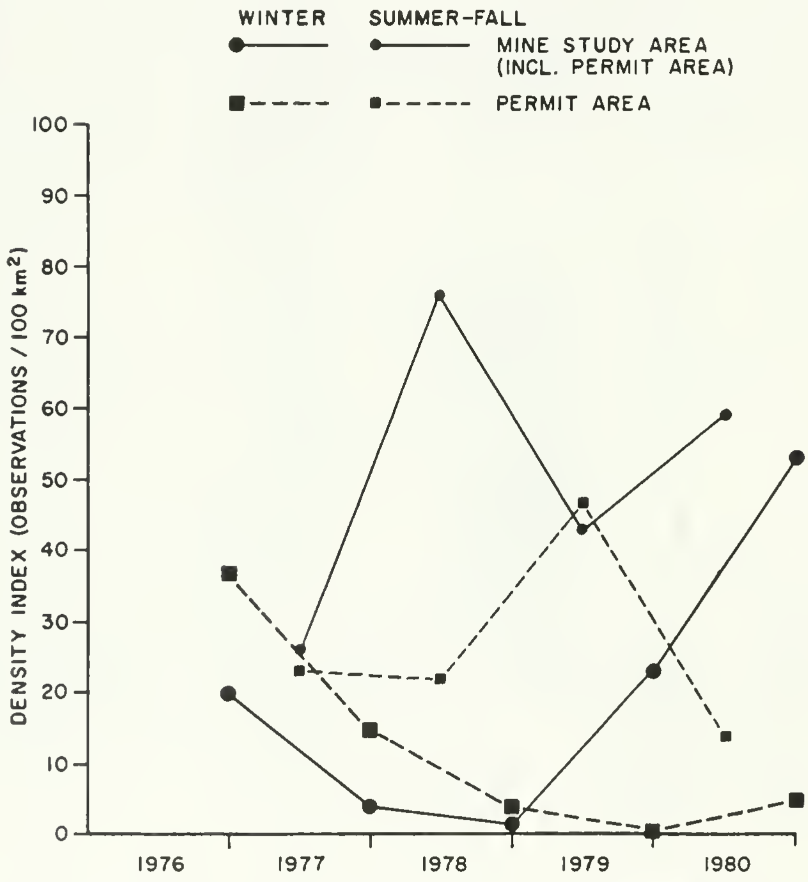

Figure 10. Year-to-year changes in pronghorn summer and winter density indices for the Circle West study areas (based on the largest aerial censuses obtained for the mine study area during July-October and December-February, respectively).

Table 9. Summary of July 1980 pronghorn aerial census, Hunting District 650.

Census Unit[1]	Time (min.)	Bucks		Does	Fawns	Total	Bucks/ 100 does	Fawns/ 100 does
		Adult	Yearling					
1	95	7	6	9	9	31	144	100
2	100	5	3	14	5	27	57	36
3	100	12	8	27	32	79	74	119
4	125	4	3	35	45	87	20	129
5	135	27	3	34	40	104	88	118
6	140	13	5	35	44	97	51	126
7	105	28	8	55	61	152	65	111
8	165	2	4	32	31	69	19	97
9	135	12	24	42	41	119	86	98
10	100	3	5	19	16	43	42	84
11	145	11	4	59	53	127	25	90
12	125	22	20	77	77	196	55	100
13	80	5	0	56	47	108	9	84
Total	1550	151	93	494	501	1239	49	101

[1] Units 9, 11, and 12 include portions of the Mine Study Area.

create density index isopleths that show general patterns of distribution (Figures 11 and 12). As indicated on these figures, pronghorn are most commonly found in the southwestern, south-central, and northwestern portions of the Mine Study Area in summer. During the mild winter of 1980-1981, pronghorn were very abundant on the rolling grassland and sagebrush areas immediately southwest of the Mine Study Area.

BIRD COMMUNITY PARAMETERS

Waterfowl Communities

The drought conditions present during the spring and summer of 1980 had a marked effect on waterfowl production; waterfowl productivity showed a drastic decline over 1979.

Breeding season species composition of all waterfowl and other large water birds observed in the Mine Study Area is presented in Table 10. Year-to-year changes in waterfowl species composition are portrayed graphically in Figure 13. Species composition was remarkably similar to that noted in 1979, with the mallard again being the predominant breeding waterfowl species.

Waterfowl breeding season census data for stockponds in the study area are summarized in Table 11. These data are converted to production and density estimates in Table 12; production is shown graphically in Figure 14. At the beginning of the 1980 breeding season, most of the larger stockponds were nearly filled and use by waterfowl was relatively high. In fact, a census estimate of the number of pairs using the Mine Study Area in 1980 indicated a substantial increase in waterfowl use from 1979 (Table 12). However, stockponds dried out rapidly over the summer and 1980 production actually showed a marked decline over 1979 (Table 12, Figure 14), dropping to approximately the level of 1977, a year of severe drought. The decrease in waterfowl use over the summer is shown on Figure 13. This can be compared to the increase observed during the summer of 1979 (DNRC 1980). Such a sharp decrease in waterfowl production is believed to be due to a decline in residual grass cover, as well as reduced water levels in the stockponds.

Waterfowl data obtained during the roadside surveys indicated a similar trend. As shown in Figure 15, both the number of species and number of observations of Anatidae and other water birds (as recorded on June surveys of five observation routes) showed a decline between 1979 and 1980.

Data on broods observed during 1980 are presented in Table 13.

Roadside Wildlife Survey

Data obtained during the 15 roadside surveys conducted in 1980 are presented in Appendix C. The cumulative numbers of species observed during all May-July runs (1977-1980) are presented in Table 14.

Table 15 summarizes 1979-1980 changes in May-July sample abundances of selected species, based on data obtained during runs of five roadside survey routes. Figure 3, which shows year-to-year changes in sample abundances of ring-necked pheasants, exhibits the type of graphs that were prepared to monitor individual species.

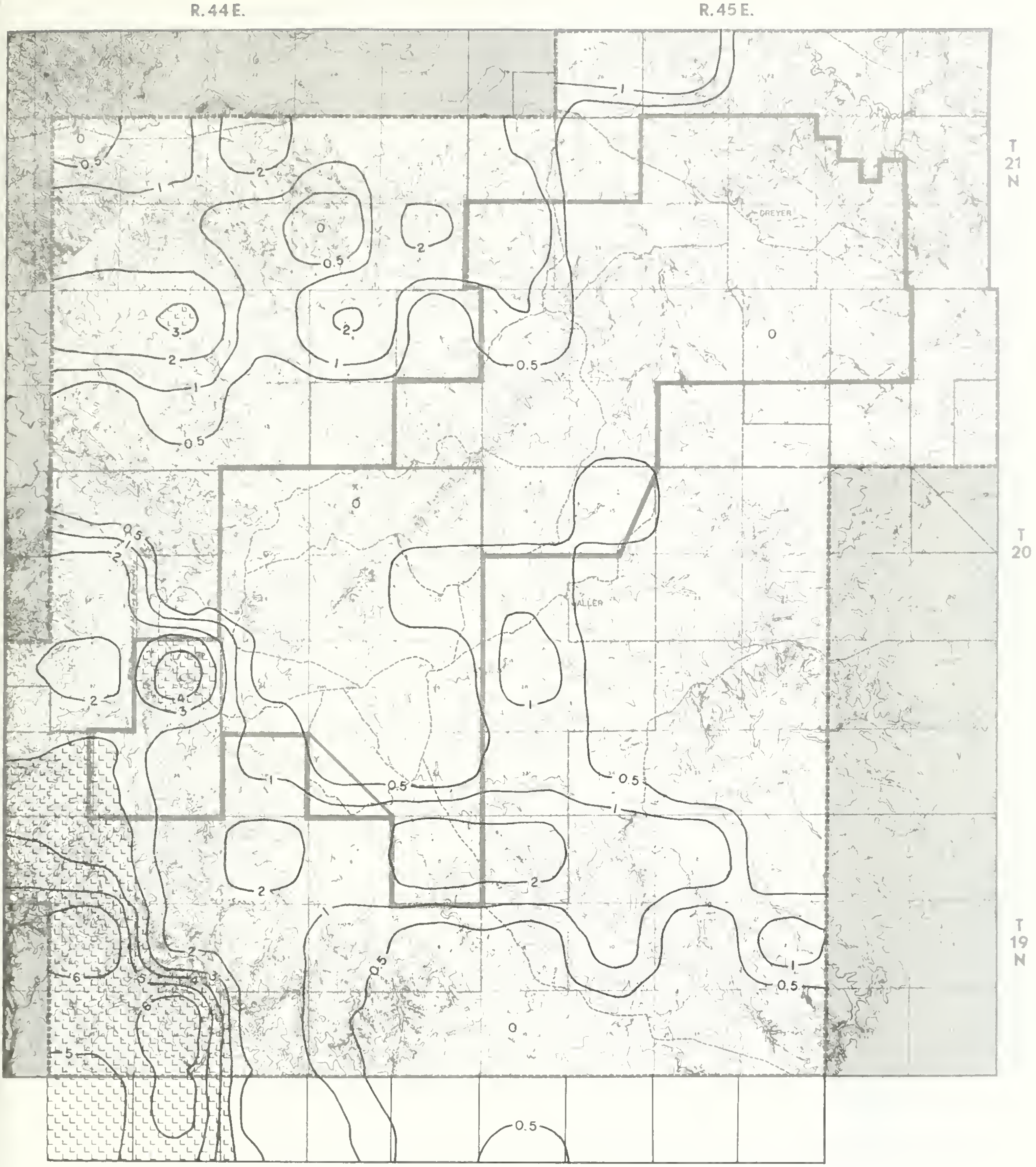

FIGURE 11. PRONGHORN SUMMER DENSITY INDEX ISOPLETHS, FOUR-YEAR AVERAGE, 1977-80

(NOTE: Areas with a summer density index greater than 3.0 are cross-hatched.)

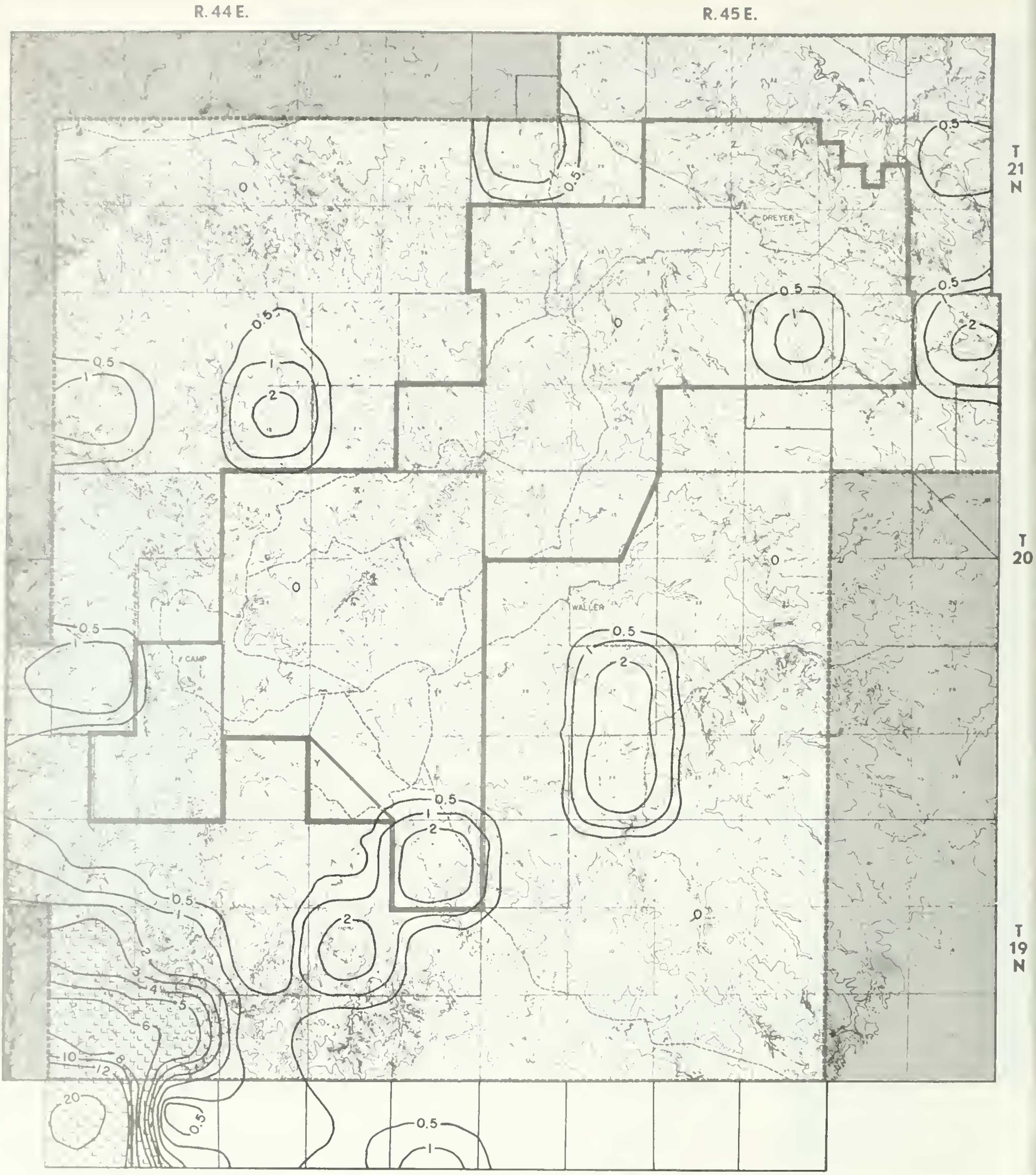

FIGURE 12. PRONGHORN WINTER DENSITY INDEX ISOPLETHS, FIVE-YEAR AVERAGE, 1976-81

(NOTE: Areas with a winter density index greater than 3.0 are cross-hatched.)

Table 10. Species composition of all recorded waterfowl and large water bird observations in the 113-section mine study area during the breeding season (May-July), 1980.

	May-July 1980
Ducks and Geese	
Canada Goose	16(1)[1]
Mallard	722(45)
Gadwall	78(5)
Pintail	66(4)
Green-winged Teal	89(6)
Blue-winged Teal	273(17)
Cinnamon Teal	1(tr)
American Wigeon	222(14)
Northern Shoveler	57(4)
Redhead	2(tr)
Ring-necked Duck	-
Canvasback	6(tr)
Lesser Scaup	36(2)
Bufflehead	-
Ruddy Duck	20(1)
Hooded Merganser	-
Red-breasted Merganser	-
Total Classified	1588(100)
Total Unclassified	392
Grand Total	1980
Other Large Water Birds	
Common Loon	1
Eared Grebe	55
Western Grebe	2
Pied-billed Grebe	18
White Pelican	15
Double-crested Cormorant	37
Great Blue Heron	16
Black-crowned Night Heron	1
American coot	12
Wilson's Phalarope	184
Ring-billed Gull	12
Common Tern	1
Black Tern	22
Belted Kingfisher	1

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[1] Numbers observed (percent of all waterfowl identified to species).

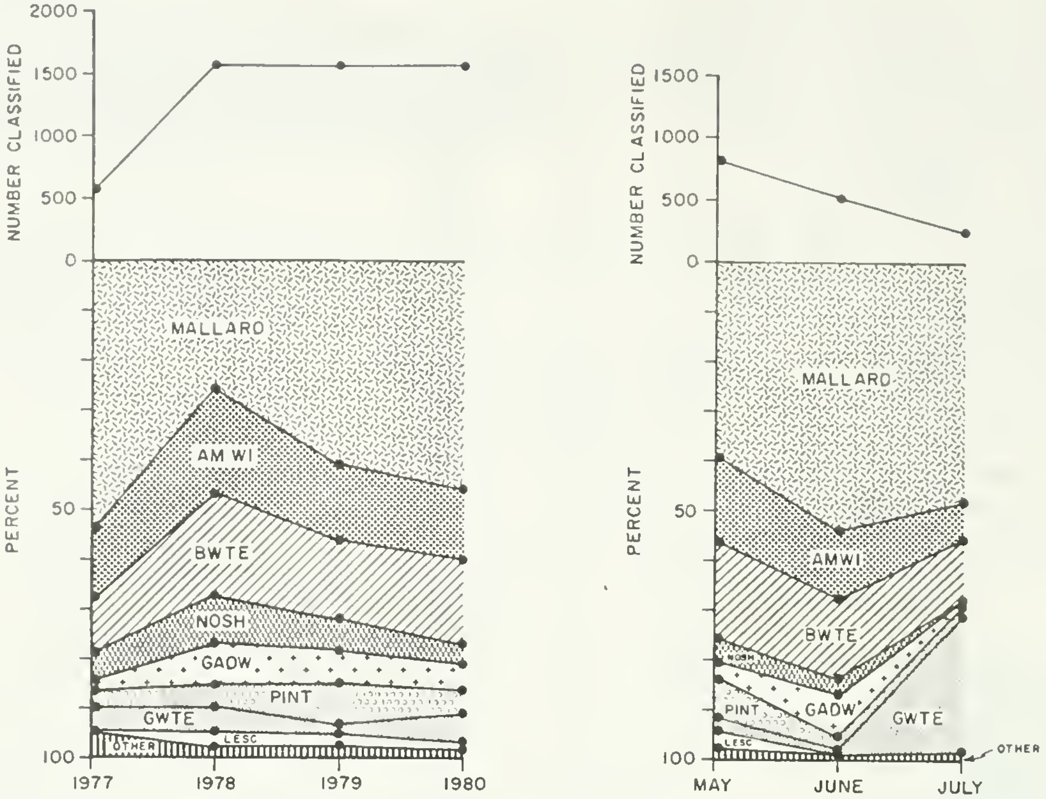

Figure 13. Percent species composition of all recorded 1980 waterfowl observations, Circle West study area (1977-1980 changes also shown).

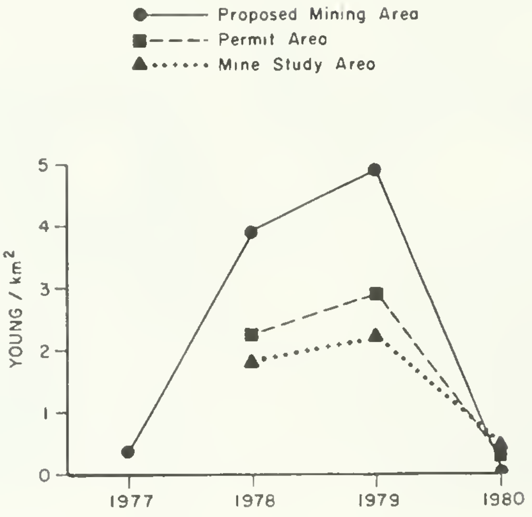

Figure 14. Year-to-year changes in waterfowl production, Circle West study areas.

Table 11. Summary of waterfowl breeding season census data for stockponds in the Circle West Mine Study Area, 1980.

Species	Proposed Mining Area[1]	Permit Area[2]	Mine study Area[3]
Mallard	10(0,0)[4]	39(2,6)	130(13,67)
Gadwall	3(0,0)	5 (0.0)	22(0,0)
Pintail	4(0,0)	9(2,8)	26(2,8)
Green-winged Teal	-	-	2(0,0)
Blue-winged Teal	5(0,0)	10(0,0)	41(0,0)
Cinnamon Teal	1(0,0)	1(0,0)	1(0,0)
American Wigeon	3(0,0)	8(0,0)	35(2,6)
Northern Shoveler	2(0,0)	3(0,0)	6(0,0)
Redhead	-	-	1(0,0)
Lesser Scaup	-	-	1(0,0)
Ruddy Duck	-	-	4(0,0)
Unidentified Duck	-	0(1,10)	0(8,39)
TOTAL ANATIDAE	28(0,0)	75(5,24)	269(25,120)

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[1] Includes stockponds Nos. MA01-10, MAFW, and MASW

[2] Includes all ponds in proposed mining area plus: MC05-08, NC10, 11, 13-15, 21, 23, 24, 27, 31

[3] Includes all ponds in 113-section area

[4] Minimum number of indicated pairs (number of broods, minimum number of young known present)

Table 12. Summary of 1980 waterfowl production data, Circle West study area.

	PMA[6]	PA[6]	MSA[6]
No. Stockponds Visited	10	24	52
No. Stockponds Censused	10	24	52
Area Censused[1]	30(11.5)	78(31.5)	293(113)
Water Area Censused[2]	3.0(7.5)	9.0(22.5)	26.0(64.0)
Minimum No. Pairs[3]	28	75	269
No./Total Area Censused[4]	0.9(2.4)	1.0(2.4)	0.9(2.4)
No./Water Area Censused[5]	9.3(3.7)	8.4(3.4)	10.5(4.3)
Broods	0	5	25
No./Total Area Censused[4]	0	0.1(0.2)	0.1(0.2)
No./Water Area Censused[5]	0	0.6(0.2)	1.0(0.4)
Young	0	24	120
No./Total Area Censused[4]	0	0.3(0.8)	0.4(1.1)
No./Water Area Censused[5]	0	2.7(1.1)	4.7(1.9)

[1] km^2 (mi^2)

[2] ha (acres)

[3] including brood data

[4] km^{-2} (mi^{-2})

[5] ha^{-1} (acres^{-1})

[6] PMA= Proposed Mining Area (11.5 sections); PA = Permit Area; MSA = Mine Study Area (113 sections)

Table 13. Average sizes of waterfowl broods recorded in the Mine Study Area during 1980.

Mallard	5.1 (1-12,n=13)
Pintail	4.0 (3-5,n=2)
American Wigeon	3.0 (2-4,n=2)

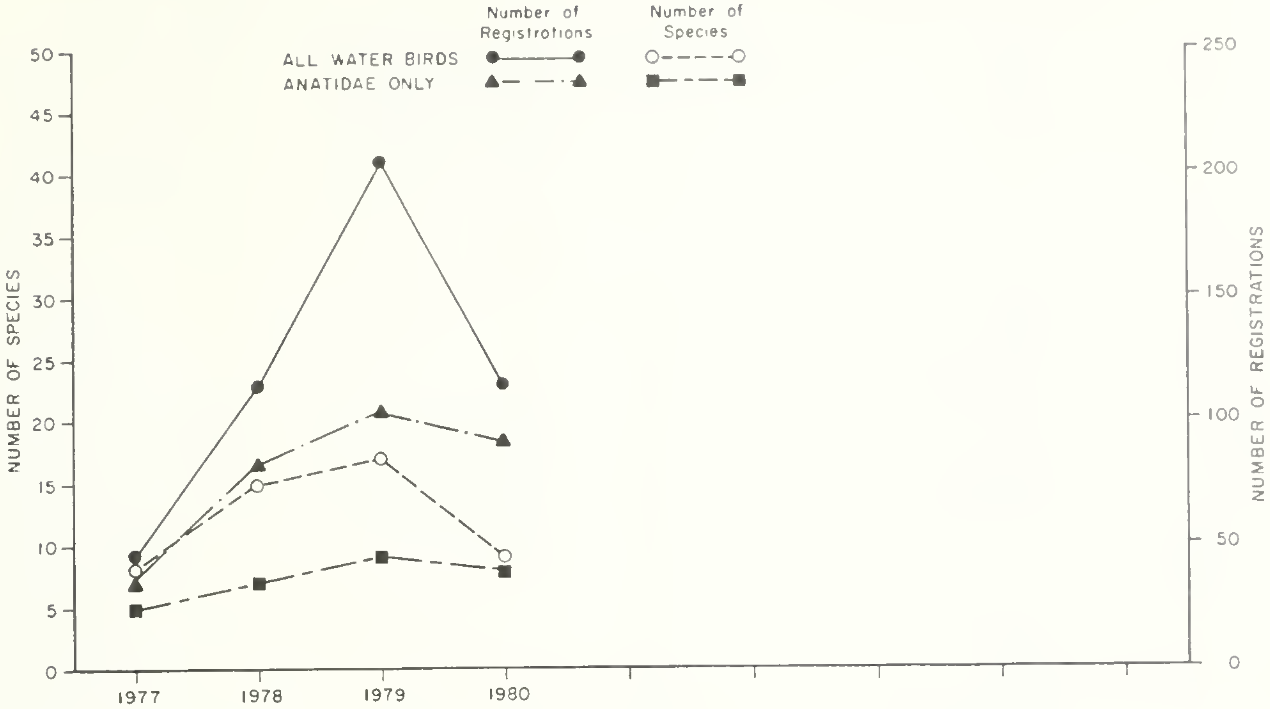

Figure 15. Year-to-year changes in numbers of species and numbers of registrations of water birds recorded on June runs of five roadside wildlife survey routes, Circle West study area.

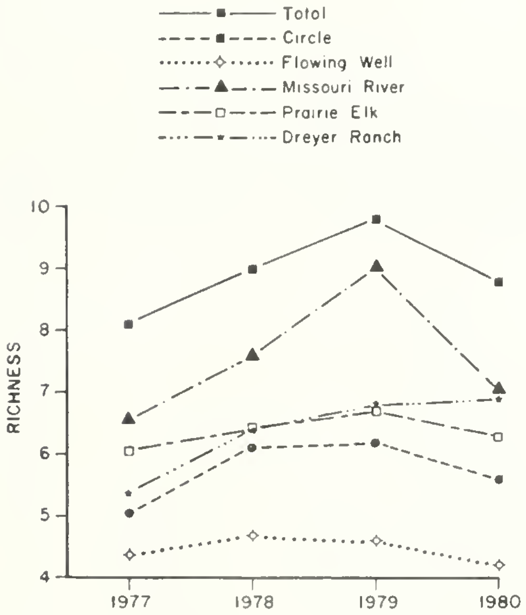

Figure 16. Year-to-year changes in June breeding bird species richness for five roadside wildlife survey routes, Circle West study area.

Table 14. Summary of cumulative numbers of species observed during May through July roadside counts, Circle West study area.

	Baseline Study (1977 runs), Five routes	Through First Monitoring Period (1977-1978 runs), Five routes	Through Second Monitoring Period (1977-1979 runs), Five routes	Through Third Monitoring Period (1977-1980 runs), Five routes
AMPHIBIANS				
Total number of Species	2(50.0)[1]	2(40.0)	2(40.0)	2(40.0)
REPTILES				
Total number of Species	1(14.3)	1(14.3)	1(14.3)	1(14.3)
BIRDS				
Total number of Species(T)	88(66.3)	110(68.8)	114(69.5)	115(68.5)
Summer Residents(S)	72(84.7)	84(91.3)	85(91.4)	85(90.4)
Permanent Residents(P)	15(88.2)	16(94.1)	16(94.1)	16(94.1)
Non-breeding Summer Visitors(V)	1(33.3)	1(20.0)	3(60.0)	3(50.0)
Migrants(M)	0(0.0)	9(25.0)	10(25.6)	11(26.8)
Winter Residents(W)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Total Breeding(S&R)	87(85.3)	100(91.7)	101(91.8)	101(91.0)
MAMMALS				
Total number of Species	14(53.9)	15(55.6)	15(55.6)	15(53.6)
TOTAL VERTEBRATE SPECIES	105(59.7)	128(64.3)	132(65.0)	133(63.9)

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[1] Number of species (percentage of cumulative totals for reconnaissance study area, Table 3).

Table 15. Summary of 1979-80 changes in May-June sample abundances of selected species sampled by five roadside survey routes, Circle West study area.

Species	1979-80 Change
Sharp-tailed Grouse	NS
Ring-necked Pheasant	NS
Killdeer	NS
Mourning Dove	NS
Common Nighthawk	NS
Eastern Kingbird	NS
Horned Lark	D*
Black-billed Magpie	I*
Rock Wren	NS
Brown Thrasher	NS
Sprague's Pipit	D**
Loggerhead Shrike	NS
Yellow Warbler	NS
Common Yellowthroat	NS
House Sparrow	NS
Western Meadowlark	D**
Red-winged Blackbird	NS
Rufous-sided Towhee	NS
Lark Bunting	NS
Savannah Sparrow	NS
Grasshopper Sparrow	D**
Baird's Sparrow	D**
Vesper Sparrow	NS
Brewer's Sparrow	D*
Chestnut-collared Longspur	D*

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[1] NS=no significant change; D=significant decrease; I=significant increase

*$.01<P\leq.05$ (paired t-test)

**$P\leq.01$

Year-to-year changes in bird species richness, logarithmic standard deviation (sigma), and number of species (excluding visitors, migrants, and water birds) for June runs of the five roadside survey routes are shown in Figures 16-18. Note that the relative positions of the routes on these graphs remain fairly constant from year to year. Figure 19 shows the species curve obtained by pooling 1977-1980 May-June data for the five routes combined; also note that this species curve is remarkably similar to those based on earlier data, and that the mode of the curve advances almost exactly one octave to the right with each doubling of sample size.

No new breeding species were observed in 1980 (Table 14). When all May-July data for the period 1977-1980 are pooled, the number of breeding species actually observed is 101 (Table 14), and the theoretical number of species present in the sampling universe is 104. Sampling of the habitats along the five routes, therefore, appears to be 97% complete. For individual routes, sampling completeness based on pooled May-July 1977-1980 data ranges from 83% to 93%. Even though less than 2% of the Reconnaissance Study Area was sampled by the roadside survey method, the method appears to be very effective for determining bird species composition. May-July 1977-1980 runs (a total of 60) recorded 90% of all breeding species and 89% of all permanent residents observed during the four-year study period (Tables 3, 14).

For the Circle Route, similarity between 1979 and 1980 runs was 86% (Figure 20).

SMALL MAMMAL COMMUNITY PARAMETERS

Small mammal capture data for 1980 are summarized in Table 16.

Figure 21 shows year-to-year changes in small mammal biomass for six habitats (biomass estimates obtained for control and experimental sites were averaged for combined spring and fall data). It should be noted that 1977 data are not strictly comparable, since a spring-fall trapping regime was not used that year. Nonetheless, it is clear from this figure that tall coulee shrub habitats consistently yielded the greatest biomass during all four years. An overall decrease in small mammal biomass between 1979 and 1980 is apparent.

Figure 22 shows year-to-year changes in the spring-fall small mammal biomass increase (which is related to production) for the same four habitats. Surprisingly, small mammal biomass in tall coulee shrub habitats decreased sharply over the summer of 1980. This is in contrast to a remarkable increase in biomass during the summer of 1979.

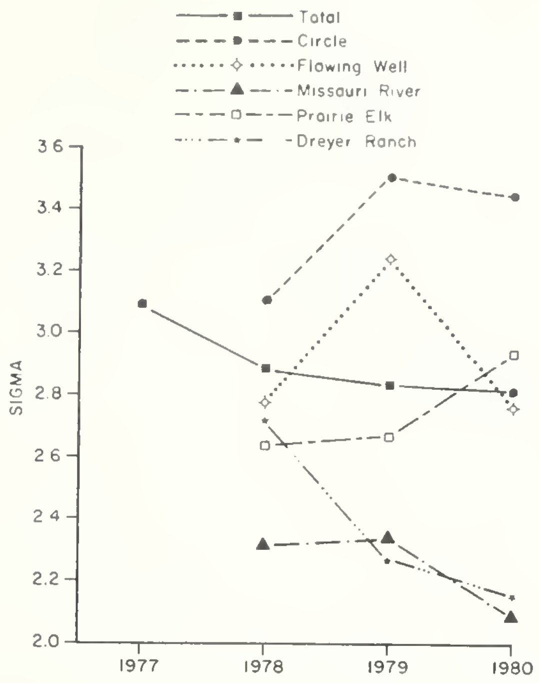

Figure 17. Year-to-year changes in June breeding bird community sigma for five roadside wildlife survey routes, Circle West study area.

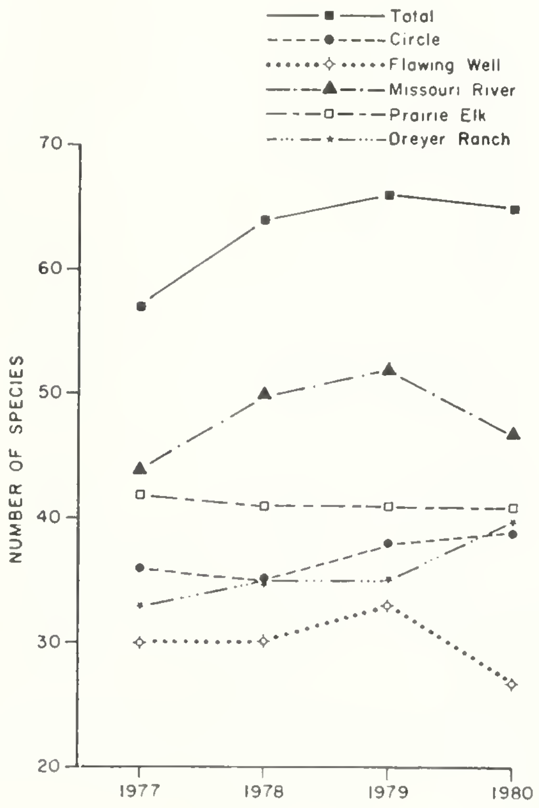

Figure 18. Year-to-year changes in June breeding bird species number (exclusive of summer visitors and water birds) for five roadside wildlife survey routes, Circle West study area.

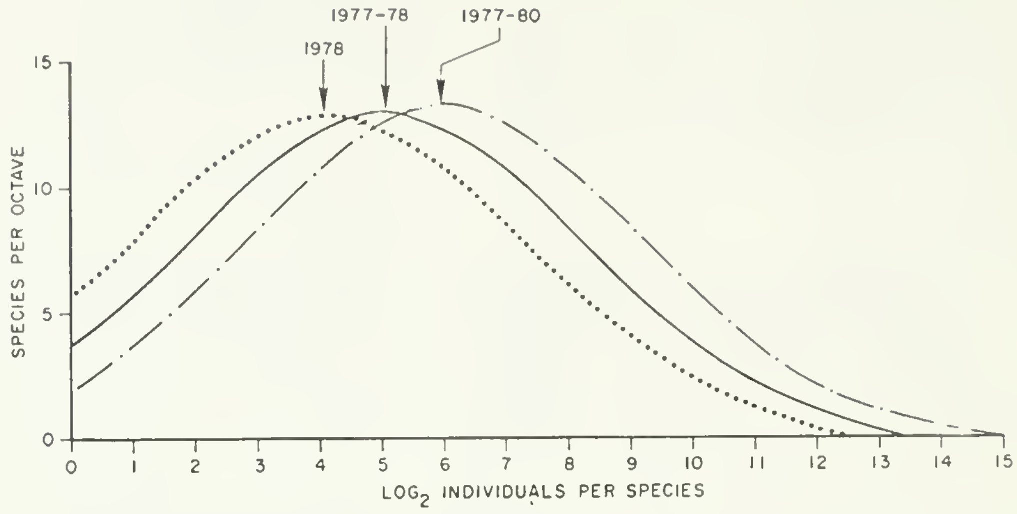

Figure 19. Year-to-year changes in cumulative May-July species curves for breeding birds encountered on five roadside wildlife survey routes, Circle West study area, 1977-1980.

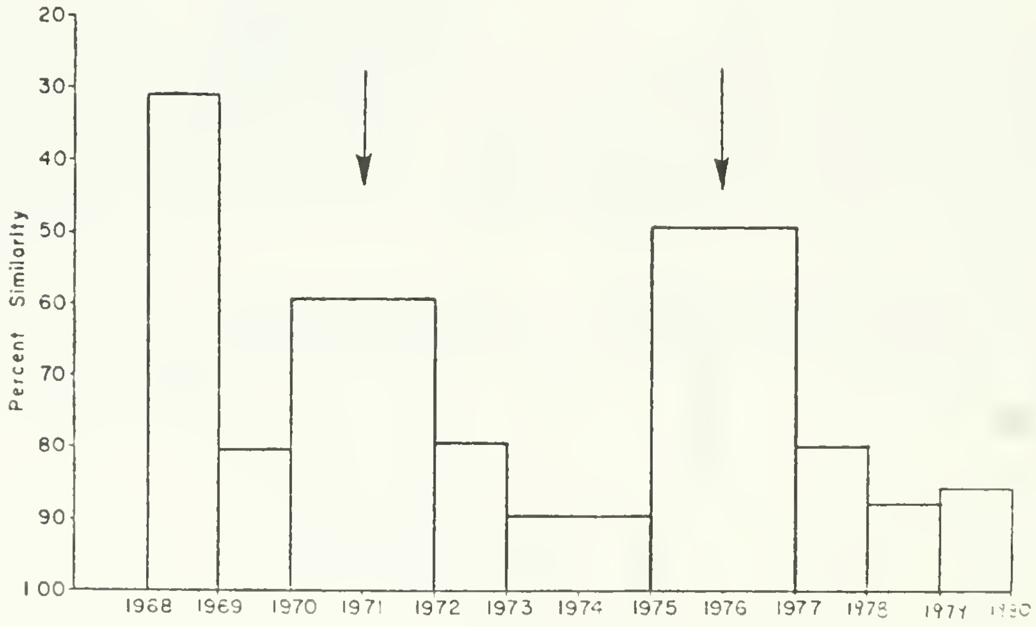

Figure 20. Similarity in percent for 1968-1980 June runs of the Circle roadside wildlife survey routes(arrows indicate change in observers).

TABLE 16. SUMMARY OF SMALL MAMMAL TRAPPING DATA
CIRCLE WEST STUDY AREA, MAY - OCTOBER, 1980

Habitat Category	Blue grama-Needle-and-thread Grassland		Western Bulrush		Silver Sagebrush		Tall Coulee Shrubbery		Coulee Trunk		Scoria		Totals
Treatment[1]	E	C	C	E	C	E	C	E	C	E	C	E	
Location Number	34	17	15	20	33	18	44	35	49	48	47	46	all
Number of trapnights (TN)	300	300	300	300	300	300	300	300	300	300	300	300	3600
Trapping Schedule[2]	5/9-10	5/9-10	5/9-10	5/9-10	5/9	5/9	5/9	5/9	5/9	5/9	5/9-10	5/9-10	--
Captures/100 TN													
Deer Mouse	0.67	1.00	--	--	1.33	1.67	9.00	1.65	4.00	3.67	2.67	4.00	2.47
Western Harvest Mouse	--	--	--	--	0.33	--	--	--	--	--	--	--	0.03
Masked Shrew	--	--	0.67	--	--	--	--	0.67	--	--	--	--	0.11
Thirteen-lined Ground Squirrel	--	--	--	0.33	--	--	--	--	--	--	--	--	0.03
Total Captures/100 TN	0.67	1.00	0.67	0.33	1.67	1.67	9.00	2.42	4.00	3.67	2.67	4.00	2.64
Number of Species	1	1	1	1	2	1	1	2	1	1	1	1	4
Biomass (g/100 TN)	12.33	19.33	4.00	38.33	28.00	34.00	169.00	38.33	74.67	55.67	49.67	71.67	49.58
Biomass Increase (g/100 TN)[3]	8.67	38.67	-8.00	-76.67	5.33	28.00	-104.67	76.67	-34.67	38.00	-8.67	63.33	2.17

[1] C = Control; E = Experimental

[2] Month of first trapping/Months of last trapping

[3] Change in biomass between May and September/October sampling = (September/October biomass - May biomass) ÷ 1.50

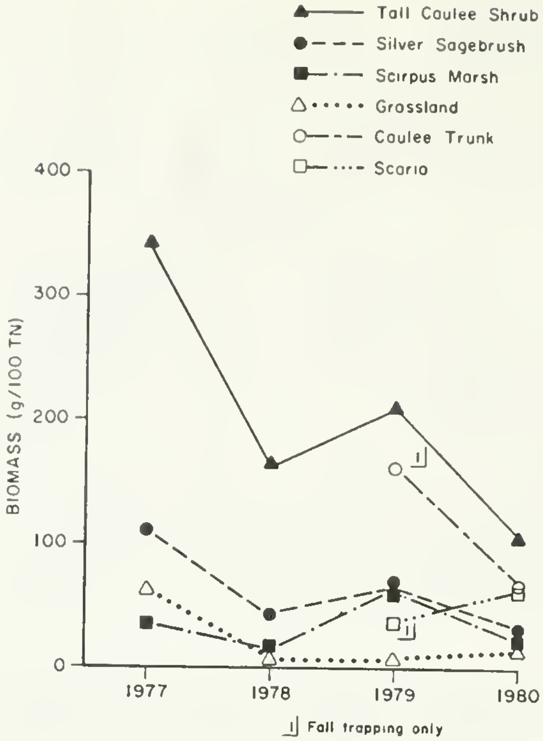

Figure 21. Year-to-year changes in small mammal biomass for six habitats sampled in the Circle West study area (control and experimental data are averaged for combined spring-fall data for each habitat).

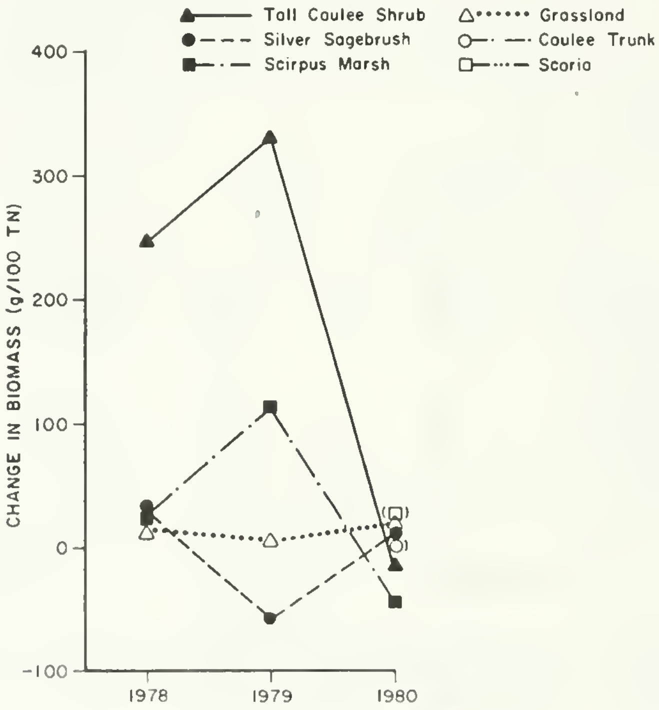

Figure 22. Year-to-year changes in spring-fall small mammal biomass change for six habitats sampled in the Circle West study area (control and experimental data are averaged for each habitat).

AREAS OF SPECIAL CONCERN

In the wildlife baseline study final report (DNRC 1978:191-193), wildlife species or habitats of special concern were identified and briefly discussed. The 4.5-year data base gathered to date, however, allows these areas of special concern, which are important over the long term, to be more accurately defined. This 4.5-year study period has included two moist years and two drought years, as well as two severe winters and parts of three relatively mild winters. As could be expected, wildlife use patterns varied greatly with the changes in weather patterns. Nevertheless, some generalizations can be drawn based on the long-term data. Areas of special concern in the Mine Study Area, as shown in Figures 8, 11, 12, 23, and 24, are discussed below.

Dendritic Silver Buffaloberry Coulees

Perhaps the most unique habitat identified in the Mine Study Area is the "tall coulee shrub" habitat described in the baseline study (DNRC 1978). This habitat occurs in steep-walled, deeply-eroded dendritic coulees usually found near ridgetops at the heads of drainages. Silver sagebrush and snowberry-rose low shrub communities commonly occur on the relatively flat coulee bottoms, while the upper reaches of the coulees and sheltered areas along the coulee trunk support an unusually mesic and diverse assemblage of tall shrubs, most often dominated by dense clones of silver buffaloberry. These sheltered areas also include red-osier dogwood, serviceberry, chokecherry, and (rarely) green ash and cottonwood. Dense stands of silver buffaloberry often occur on moderate slopes adjacent to the Missouri River floodplain, and occasionally near the heads or edges of box elder and green ash dominated "hardwood draws" typically found further east in Montana and North Dakota (Swenson 1981). It is not known whether silver buffaloberry occurs in combination with red-osier dogwood and deeply-eroded coulee topography outside southern McCone, northern Prairie, and east-central Dawson counties, Montana.

Nowhere in this area were more well-developed examples of this vegetative-topographic complex observed than in the northeastern portion of the Permit Area. The most well-developed such coulee system is found here, and is delineated in Figure 23, which shows the approximate distribution of silver buffaloberry in the Mine Study Area. This coulee system provides important spring-fall cover for deer, and is a key component of the major sharp-tailed grouse breeding-wintering complex. Many species of birds depend on silver buffaloberry for nest sites; a breeding bird census plot located in this coulee system supported the greatest species diversity of all habitats sampled (DNRC 1978, 1979). Also, small mammal biomass was greatest in tall coulee shrub and coulee trunk habitats throughout the study period (Figure 21), while the change in small mammal biomass from spring to fall was greatest here in all years except 1980. Most of the recommendations for future monitoring (see the following chapter) are designed to further explain the structure, origin, and suggested importance of this coulee system.

Waterfowl Production Areas

Waterfowl production in the Mine Study Area is not remarkably high, although production in the original Proposed Mining Area was nearly 5/km during the very wet year of 1979 (Figure 14). The eight most important stockponds in the Mine Study Area for waterfowl production, with their adjacent upland nesting areas, are indicated in Figure 24. These are the stockponds which had an average

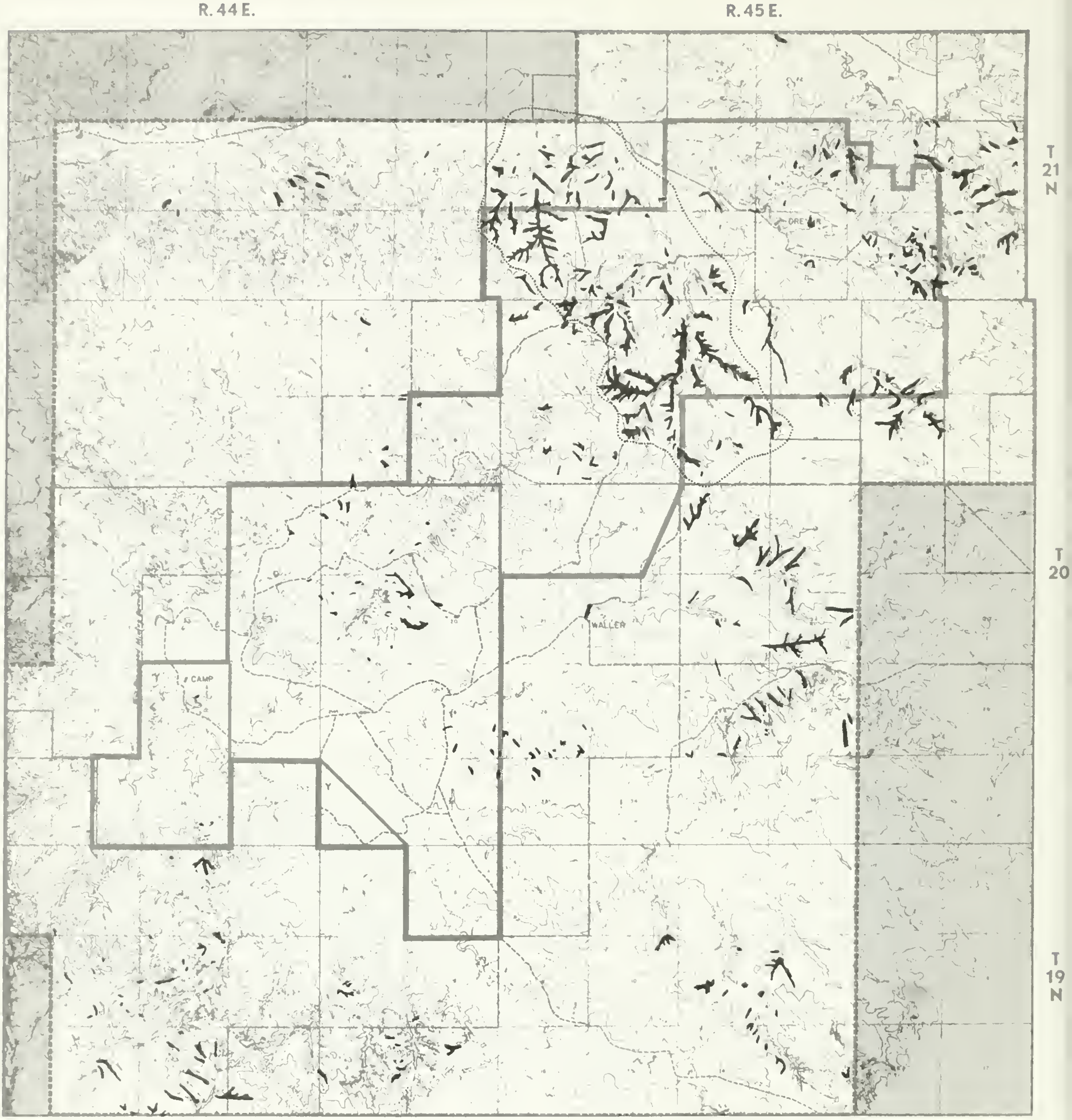

FIGURE 23. SILVER BUFFALOBERRY AND DENDRITIC COULEES

LEGEND

▲ SILVER BUFFALOBERRY

◌ MAJOR DENDRITIC COULEE SYSTEM

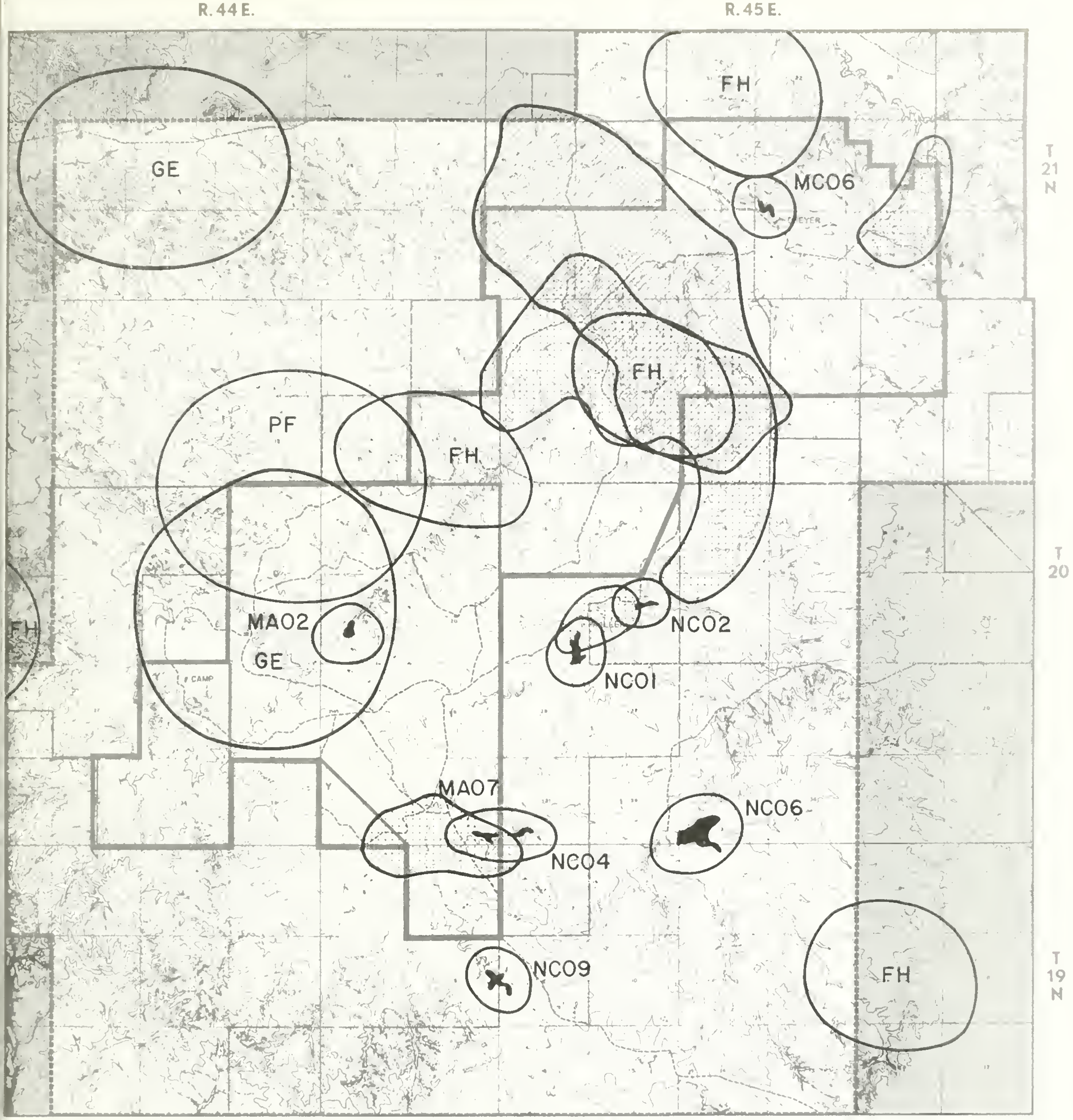

FIGURE 24. AREAS OF SPECIAL CONCERN

NOTE: Big Game areas of special concern are shown in Figures 8, 11, and 12.

LEGEND

○ SHARP-TAILED GROUSE BREEDING/WINTERING AREAS

NC02 ○ MAJOR WATERFOWL PRODUCTION AREAS

(GE) GOLDEN EAGLE NESTING AREA (APPROXIMATE)

(PF) PRAIRIE FALCON NESTING AREA (APPROXIMATE)

(FH) FERRUGINOUS HAWK NESTING AREA (APPROXIMATE)

○ DENDRITIC COULEE SYSTEM

annual production of 10 young or more from 1977-80. Their ranking from highest to lowest average production is as follows (average 1977-1980 production is shown in parentheses after the stockpond code): NC09 (30), MA07 (27), NC01 (24), MC06 (21), NC06 (20), MA02 (18), NC02 (15), and NC04 (11). Of these, MA07, MA02, and NC01 produced young only during the very wet years of 1978 and 1979. Stockponds MC06, NC04, NC09, NC02, and NC06 contained water during the dry years of 1977 and 1980, and were among the most productive stockponds in the area those years.

Raptor Nesting Areas

One of the most notable features of the Mine Study Area is its unusual variety and density of raptors (DNRC 1978, 1979, 1980); seven species are known to nest in the Permit Area. Although some raptors have occupied the same nests since the studies began, considerable year-to-year movement among alternate nest sites, particularly in the case of the buteos, has taken place. For this reason, as well as to ensure protection of the nest sites, only the approximate locations of nesting areas (which have been active at least one year during the study and which may contain several alternative nest sites), and not the exact location of nest sites, are shown on Figure 24. Nesting areas are shown only for the the three raptor species of greatest concern--the golden eagle, prairie falcon, and ferruginous hawk.

Sharp-tailed Grouse Breeding-Wintering Complexes

The Permit Area includes at least three major breeding-wintering areas for sharp-tailed grouse (Figure 24). Although some leks were used by displaying males each year of the study, locations of leks in general, particularly the smaller ones, changed considerably from year to year. The grassland and coulee habitats along the Nelson-McGuire Creek divide provide important overwintering habitat near displaying and nesting areas.

Mule Deer Habitat

The Mine Study Area supports a substantial mule deer population throughout the year, although spring-fall distribution and density, due to decreased observability, are less well known than winter density. Aerial survey data allow wintering areas that are important year after year to be identified (Figure 8). In Figure 8, areas which have an average 1977-1980 mule deer winter density index of 2 or greater are shown by crosshatching; these areas should be considered important components of key wintering areas. Further study is needed to determine mule deer density, movements, and distribution at other seasons; a recommended study plan is presented in the following chapter.

Pronghorn Habitat

The monitoring study has shown that the Permit Area provides important summer and winter habitat for pronghorns. In Figures 11 and 12, areas which have a long-term average density index of 3 or greater are indicated by crosshatching; these should be considered key use areas. The substantial pronghorn population southwest of the Mine Study Area should be investigated in more detail during future aerial surveys of the area (see following section, Recommendations for Future Monitoring).

RECOMMENDATIONS FOR FUTURE MONITORING

With the conclusion of this monitoring study, four to five years' data have been gathered on wildlife populations in the study area. The study period has included very wet and very dry years, and severe as well as mild winters. Data gathered over the entire study period, therefore, present a much clearer long-term assessment of wildlife use of the study area than would be observed during a one-year baseline study. For example, 1977 was an unusually dry year with a severe winter; had wildlife investigations been limited to this year's baseline study alone, very different conclusions concerning wildlife use and distribution would have been reached. White-tailed deer, winter mule deer, and pronghorn use of the Mine Study Area would have been greatly underestimated (Figures 6, 10) and many raptor nesting areas that were not occupied in 1977 would not have been identified. On the other hand, ring-necked pheasant and white-tailed jackrabbit abundances would have been greatly overestimated (Figures 3, 4). Also, the importance of study area stockponds as waterfowl production areas would not have been documented (Figure 14); in fact, stockponds MA07, MA02, and NC01--which were among the most productive ponds during the 1980-81 study period--produced no young at all during 1977. In all, 33 wildlife species that were absent or undetected in 1977 would not have been documented (Table 3). In view of this monitoring program's ability to reveal long-term wildlife distribution patterns and trends, it is recommended that monitoring of the parameters discussed in this report be continued.

Future studies, however, should not be limited only to monitoring these parameters. Emphasis should also be placed on gathering more precise information regarding the special concerns previously mentioned; such information will be critical for developing acceptable mining and reclamation plans. It has become obvious, for example, that the dendritic coulee system shown in Figure 23 is of great importance to wildlife; this coulee system was not included in the original Proposed Mining Area, although it now falls largely within the new Permit Area. Thus, its importance should be further investigated. Likewise, it also is apparent that the study area supports important pronghorn and mule deer populations, and that additional data on movements, spring-fall distribution, and seasonal populations will be necessary to assess mitigation and reclamation needs.

To facilitate the collection of more monitoring data and information regarding areas of special concern, the following modifications or additions to the present monitoring plan are recommended:

Dendritic Coulee Foot Routes

Two routes, shown in Figure 25, should be walked on two consecutive mornings during each month of field study, beginning at local sunrise. Total numbers of each vertebrate species seen or heard on each route should be recorded on standard data sheets and tallied according to extent of tall coulee shrub habitat use (see Appendix D for a detailed description of the method to be used). All observations of wildlife should be mapped.

Dendritic Coulee Habitat Description

Dendritic coulee habitats should be described quantitatively using a modification of the methods employed by Daubenmire (1959), Nudds (1977), and Nobel et al. (1980). Vertical structure and species diversity of vegetation,

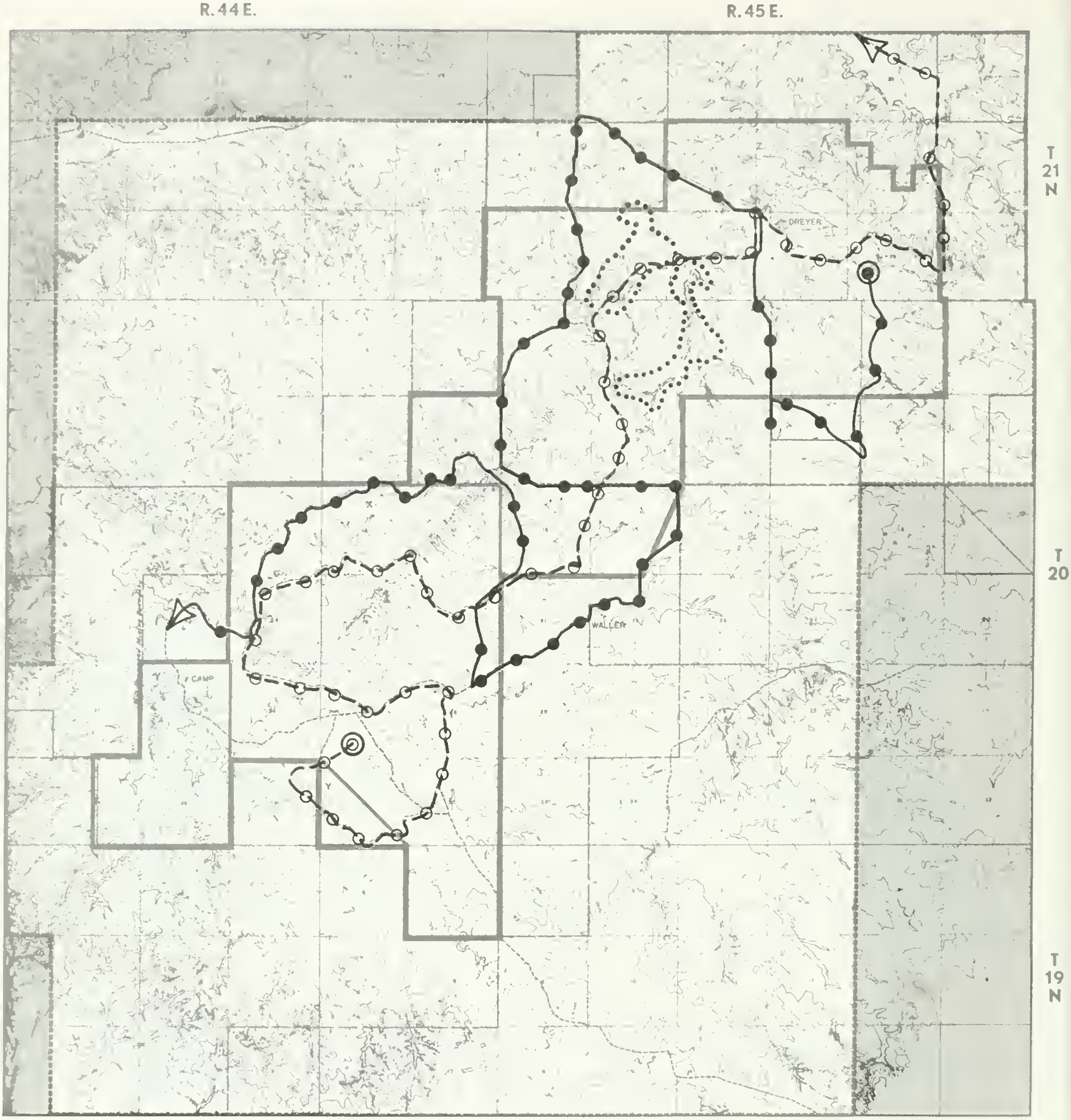

FIGURE 25. ROADSIDE WILDLIFE SURVEY ROUTES AND DENDRITIC COULEE FOOT TRANSECTS

LEGEND

○- -○- -○ ○ DREYER ROUTE

START ◎●—●—●—●▷ END

●—●—●—● WALLER ROUTE

•••••••• DENDRITIC COULEE FOOT TRANSECTS slope, aspect, position in the coulee system, and soil texture should be measured at many sites in the coulee system, and a multivariate analysis should be used to identify the major edaphic factors that contribute to the presence of the tall shrub type. Researchers should attempt to determine the age, origin, history, trend and reclamation potential of the coulee system in the study area.

Mule Deer Studies

A marking and radio-tracking study should be initiated to clarify mule deer seasonal distribution patterns, abundance, movements, and habitat use. To ensure consistency with ongoing deer studies elsewhere in Montana, the methods used in this study should be developed in cooperation with the Montana Department of Fish, Wildlife and Parks and Montana State University.

Roadside Wildlife Survey

A new roadside survey route, the Waller Route (Figure 25), should be surveyed along with the Dreyer Route in May, June, and July each year. The other four routes should be surveyed in June each year, following standard methods (DNRC 1978).

Pronghorn Aerial Survey

Present aerial survey routes should be expanded to include pronghorn winter concentration areas southwest of the Mine Study Area.

Great Horned Owl Census

Great horned owl populations should be studied in February using recorded calls, as described by Youmans et al. (1981).

ACKNOWLEDGMENTS

During the 1980-81 monitoring period, data were gathered by: John Bevins, Stacy Kiser, and Dana Schmidt of OEA Research (small mammal trapping, waterfowl census, and general ground survey); Ron Stoneberg, MDFWP (aerial big game census); and Larry Thompson, DNRC (project coordination, roadside wildlife surveys, waterfowl census, and general ground surveys). George Cawlfield, Ed Madej, Chris Raver, and Larry Thompson of DNRC performed the data analysis. Dr. Robert S. Hoffman kindly verified the identity of some of the small mammal specimens collected. Joanne Brown typed the manuscript, and June Virag and Dan Nelson produced the graphics. Don Howard of DNRC's Cartography Bureau prepared the front cover illustration. The computer-generated big game density maps were prepared by Randy Holm of the Montana Department of Community Affairs. This report was prepared by Larry Thompson of DNRC and was funded by Burlington Northern, Inc. Technical editing was done by William Phippen of DNRC. Special thanks are extended to the Mike McKeever family for help in the field.

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APPENDICES

APPENDIX A. Schedule of March 1980 - February 1981 field work (exclusive of aerial surveys), Circle West Wildlife Monitoring Study (NOTE: See Table 6 for schedule of aerial surveys).

Date	Observer(s)	Type of Field Work	Approximate No. Person-Days
March 18-22	DS[1]	Ground surveys, lek counts	5
April 22-25	DS, SK	Ground surveys, lek counts	8
May 18-23	LT	Ground surveys, waterfowl census, raptor nest census, roadside wildlife survey, lek counts	6
May 20-27	SK	Ground surveys, waterfowl census, raptor nest census, small mammal trapping	8
June 9-15	LT, SK	Ground surveys, waterfowl census, raptor nest census, roadside wildlife survey	14
July 7-12	LT	Ground surveys, waterfowl census, raptor nest census, roadside wildlife survey	6
July 29-Aug 4	SK	Ground surveys, waterfowl census, raptor nest census, roadside wildlife survey	7
Sept 25-Oct 2	SK, JB	Ground surveys, small mammal trapping	16
Oct 29-Nov 4	JB	Ground surveys, lagomorph survey	7
Dec 9-11	JB	Ground surveys	3
Jan 27-29	JB	Ground surveys	3
Feb 24-26	JB	Ground surveys	3
		TOTAL	86

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[1] JB=John Bevens, SK=Stacy Kiser, DS=Dana Schmidt, LT=Larry Thompson

APPENDIX B

Wildlife Habitat Categories, Circle West Baseline Wildlife Study.

Woodland Series	Shrubland Series	Grassland Series	Wetland Series	Agricultural Land Series	Rights-of-Way Series	Towns and Communities	Badlands Series
CF - Cottonwood Forest	TC - Tall Coulee Shrub	LB - Little Bluestem	WM - Wet Meadow	GS - Grain, Sprouting	FR - Fence Row	TO - Towns	SC - Scoria
FG - Farm Groves and Shelter belts	LC - Low Coulee Shrub	SA - Saltgrass	CM - Cattail Marsh	GI - Grain, Intermediate	HI - Highway Embankment	OF - Occupied Farmstead	BA - Badlands Complex
Bx - Box elder/ Ash	SR - Snowberry/ Rose	GR - Grassland	SM - Scirpus Marsh	GM - Grain Mature	RD - County Road Embankment	AF - Abandoned Farmstead	BE - Bare Earth
CG - Cottonwood Groves (scattered trees)	BS - Big Sage 1/	BW - Bluebunch Wheatgrass	PR - Stockponds and Reservoirs	ST - Stubble	TL - Transmission/Telephone Line Right-of-way		
	BG - Big Sage Grassland 2/	HJ - Horizontal Juniper	AP - Alkali Ponds	FA - Fallow			
	SS - Silver Sage 1/	WW - Western Wheatgrass	PG - Pond (Grass bordered)	AL - Alfalfa			
	SG - Silver Sage Grassland 2/		PM - Pond (Marsh bordered)	WH - Wild Hayland			
	RS - Riparian Shrubbery		PW - Pond (Woodland bordered)	CU - Cultivated (Undifferentiated)			
	YU - Yucca		SH - Shore				
	WI - Willow		SW - Still Water				
	RJ - Rocky Mt. Juniper		FW - Flowing Water				

1/ > 25% canopy cover.
2/ < 25% canopy cover.

APPENDIX C. Summary of bird community parameters for five roadside survey routes.

NOTE: Results are given for each of the five routes (indicated by the first letter of the route name as follows: C=Circle, F=Flowing Well, P=Prairie Elk, M=Missouri River, D=Dreyer Ranch), and for all five routes combined (including the Dreyer Ranch route). Numbers indicate sample abundance and frequency for each species (e.g. 12/7 indicates that twelve birds were recorded at seven stops).

MAILING ADDRESS MAY 1980 SUMMARY Zip Code

	(65)	(69)	(72)	(75)	(78)	(81)	(84)	(88)
Species	AOU	ROUTE						TOTAL INCL. DRETER
		C	F	P	M	D		
PIED-BILLED GREBE . .	006							
DBL-CR. CORMORANT	120							
GREAT BLUE HERON .	194		1/1	1/1		2/1		4/3
BLK-CR. NIGHT HERON	202							
AM. BITTERN.	190							
MALLARD.	132	3/1	2/1	4/2	10/3	9/5		28/12
GADWALL	135	4/1				6/3		10/4
PINTAIL.	143				4/1	4/2		8/3
GREEN-WINGED TEAL	139				2/1			2/1
BLUE-WINGED TEAL .	140	5/1			9/2	4/2		18/5
AM. WIGEON	137	2/2			1/1	14/4		17/7
N. SHOVELER	142					2/1		2/1
WOOD DUCK	144							
REDHEAD.	146							
CANVASBACK	147							
LESSER SCAUP	149					4/1		4/1
RUDDY DUCK	167							
RED-TAILED HAWK .	337							
SWAINSON'S HAWK .	342			1/1		3/3		4/4
FERRUGINOUS HAWK .	348							
MARSH HAWK	331	4/3	2/2		X			6/5
AM. KESTREL	360		1/1		1/1			2/2
SHARP-TAIL. GROUSE	308		1/1		23/8			24/9
BOBWHITE	289							
RING-NECK PHEASANT	3091	16/11	1/1	16/15	76/43			109/70
GRAY PARTRIDGE. . .	2881	3/2			4/3			7/5
SORA	214					1/1		1/1
AM. COOT	221							
KILLDEER	273	7/5	3/3	12/10	7/5	17/13		46/36
COMMON SNIPE . . .	230							
LONG-BILLED CURLEW	264				2/2			2/2
UPLAND SANDPIPER .	261			2/2	4/3	2/1		8/6
SPOTTED SANDPIPER.	263							
WILLET	258							
MARBLED GODWIT . .	249							
AM. AVOCET	225							
WILSON'S PHALAROPE	224	13/1						13/1
RING-BILLED GULL . .	054							
FRANKLIN'S GULL . .	059							
BLACK TERN	077							
ROCK DOVE.	3131	2/1						2/1
MOURNING DOVE. . .	316	50/24	52/25	51/25	81/35	17/11		251/125
YELLOW-BIL. CUCKOO	387							
BLACK-BILL CUCKOO	388							
GREAT HORNED OWL	375							
BURROWING OWL. . .	378				1/1			1/1
SHORT-EARED OWL .	367							
COMMON NIGHTHAWK	420							
CHIMNEY SWIFT . . .	423							
BELTED KINGFISHER .	390			1/1				1/1
COMMON FLICKER .	412		2/1		6/6			8/7
RED-HD. WOODPECKER	406				1/1			1/1
HAIRY WOODPECKER	393							
DOWNY WOODPECKER	394							
E. KINGBIRD	444		2/1	8/5	4/4	3/3		17/13
W. KINGBIRD.	447	3/3			5/3	1/1		9/7
GT. CREST FLYCATCHR	452							
E. PHOEBE	456							
SAY'S PHOEBE	457	4/4	19/16		1/1	3/2		27/24
WILLOW FLYCATCHER	4664							
LEAST FLYCATCHER .	467	1/1			1/1			2/2
E. WOOD PEWEE . . .	461							
W. WOOD PEWEE . .	462	1/1						1/1
HORNED LARK	474	119/[illegible]	26/14	24/17	12/8	115/38		[illegible]/125
TREE SWALLOW . . .	614							
BANK SWALLOW . . .	616							
ROUGH-WG. SWALLOW	617	1/1		1/1		8/2		10/5

	(65)	(69)	(72)	(75)	(78)	(81)	(84)	(88)
Species	AOU	ROUTE						TOTAL INCL. DRETER
		C	F	P	M	D		
BARN SWALLOW . . .	613	7/6	6/3	12/6	13/7	3/1		41/23
CLIFF SWALLOW . . .	612	10/1	330/14		5/5	2/2		407/22
PURPLE MARTIN . . .	611							
BLUE JAY.	477							
BLK-BILLED MAGPIE .	475		1/1	1/1	8/6	X		10/8
COMMON CROW . . .	488				8/7			8/7
BLK-CAP. CHICKADEE	735							
WHITE-BR. NUTHATCH	727							
HOUSE WREN	721	3/3		4/3	19/14			26/20
LONG-BIL MARSH WREN	725							
SHORT-B. MARSH WREN	724							
ROCK WREN.	715		42/24	1/1	2/2	6/4		51/31
GRAY CATBIRD. . . .	704							
BROWN THRASHER . .	705	3/3	4/4	5/5	18/16	11/9		41/37
SAGE THRASHER . . .	702							
AM. ROBIN	761	3/3		1/1	1/1			5/5
VEERY.	756							
E. BLUEBIRD	766							
MOUNTAIN BLUEBIRD	768							
SPRAGUE'S PIPIT . . .	700					9/9		9/9
CEDAR WAXWING . .	619							
LOGGERHEAD SHRIKE.	622	1/1	1/1	2/2	1/1	3/2		8/7
STARLING.	493	16/3			4/3	1/1		21/7
RED-EYED VIREO . . .	624							
WARBLING VIREO. . .	627			2/2				2/2
YELLOW WARBLER . .	652	3/2		4/2	8/4			15/8
COM. YELLOWTHROAT	681			1/1	1/1			2/2
YELLOW-BR. CHAT. .	683			2/1	1/1			3/2
AM. REDSTART. . . .	687							
HOUSE SPARROW . . .	6882	23/6		4/1	1/1	7/1		35/9
BOBOLINK.	494	1/1						1/1
W. MEADOWLARK . .	5011	127/48	240/50	163/50	183/49	219/50		932/247
YEL-HD. BLACKBIRD.	497				2/1	1/1		3/2
RED-WG. BLACKBIRD.	498	47/22	14/8	21/12	49/14	48/16		179/72
ORCHARD ORIOLE . .	506							
NORTHERN ORIOLE .	507	2/2			1/1			3/3
BREWER'S BLACKBIRD.	510	1/1	11/7	19/11	30/13	10/6		71/38
COMMON GRACKLE .	511				18/7			18/7
BROWN-HD. COWBIRD	495	20/10	20/12	10/6	21/10	20/12		91/50
ROSE-BR. GROSBEAK .	595							
BLACK-HD. GROSBEAK	596							
BLUE GROSBEAK . . .	597							
INDIGO BUNTING . .	598							
LAZULI BUNTING . .	599							
DICKCISSEL.	604							
AM. GOLDFINCH. . .	529		1/1	8/7	5/5			14/13
RUFOUS-SIDE TOWHEE	587		3/2	1/1	19/15			23/18
LARK BUNTING. . . .	605	41/14	129/9	93/15	56/7	1/1		320/46
SAVANNAH SPARROW	542	3/3						3/3
GRASSHOPPER SPARROW	546	2/2		1/1	1/1	18/12		22/16
BAIRD'S SPARROW. . .	545	1/1				8/8		9/9
VESPER SPARROW . . .	540	14/12	60/29	16/13	28/19	15/9		133/82
LARK SPARROW	552	4/4	11/11	7/7	17/15			39/37
CHIPPING SPARROW. .	560	15/3	4/4	3/2	9/4			31/13
CLAY-COL. SPARROW	561	5/4	1/1		17/11			23/16
BREWER'S SPARROW. .	562		23/17	7/7	4/3	8/3		42/30
FIELD SPARROW. . . .	563		2/2	6/5	33/26			41/33
SWAMP SPARROW. . .	584							
SONG SPARROW. . . .	581							
MCCOWN'S LONGSPUR	539	14/8						14/8
CH-COL. LONGSPUR .	538	98/34	15/6			49/19		162/59
GOLDEN EAGLE . . .						X		X
CANADA GOOSE . . .			34/1		2/1	X		36/2
DOUBLE-CR. CORMORANT						X		X
NORTHERN PHALAROPE		2/1						2/1
SAGE GROUSE . . .			X					X

Form 3-6 (1975)

MAILING ADDRESS JUNE 1980

Zip Code

	(65)	(69)	(72)	(75)	(78)	(81)	(84)	(88)
Species	AOU	ROUTE						TOT.- INCL. SPETER
		C	F	P	M	J		
PIED-BILLED GREBE . .	006					2/1	2	2/1
DBL-CR. CORMORANT	120		3/1					3/1
GREAT BLUE HERON .	194		1/1					1/1
BLK-CR. NIGHT HERON	202							
AM. BITTERN.	190							
MALLARD.	132	57/2	X		1/1	13/4		71/7
GADWALL	135					2/1		2/1
PINTAIL.	143							
GREEN-WINGED TEAL	139			X				X
BLUE-WINGED TEAL .	140	2/1				4/3		6/4
AM. WIGEON	137		X	1/1		6/3		7/4
N. SHOVELER.	142					5/3		5/3
WOOD DUCK.	144							
REDHEAD.	146							
CANVASBACK	147							
LESSER SCAUP	149							
RUDDY DUCK	167							
RED-TAILED HAWK .	337							
SWAINSON'S HAWK .	342	1/1						1/1
FERRUGINOUS HAWK.	348		1/1			1/1		2/2
MARSH HAWK	331	1/1	1/1		1/1	1/1		4/4
AM. KESTREL	360			1/1	3/2			4/3
SHARP-TAIL. GROUSE	308			1/1	11/5	3/2		15/8
BOBWHITE	289							
RING-NECK PHEASANT	3091	22/13		19/15	54/29	3/3		98/60
GRAY PARTRIDGE. . .	2881	3/2						3/2
SORA	214							
AM. COOT	221							
KILLDEER	273	11/6	6/6	29/21	23/15	28/12		97/60
COMMON SNIPE . . .	230							
LONG-BILLED CURLEW	264				3/2			3/2
UPLAND SANDPIPER .	261			2/2	2/1			4/3
SPOTTED SANDPIPER.	263					1/1		1/1
WILLET	258							
MARBLED GODWIT . .	249							
AM. AVOCET	225							
WILSON'S PHALAROPE	224							
RING-BILLED GULL . .	054			1/1	4/3			5/4
FRANKLIN'S GULL . .	059							
BLACK TERN	077							
ROCK DOVE.	3131	5/3						5/3
MOURNING DOVE. . .	316	56/23	22/14	51/22	77/22	26/18		232/107
YELLOW-BIL. CUCKOO	387							
BLACK-BILL CUCKOO	388				1/1			1/1
GREAT HORNED OWL	375	1/1						1/1
BURROWING OWL. . .	378				2/1			2/1
SHORT-EARED OWL .	367							
COMMON NIGHTHAWK	420		11/10	4/4	5/3	12/11		32/28
CHIMNEY SWIFT . . .	423							
BELTED KINGFISHER .	390							
COMMON FLICKER .	412		1/1	1/1	12/10			14/12
RED-HD. WOODPECKER	406	1/1			3/1			4/2
HAIRY WOODPECKER	393							
DOWNY WOODPECKER	394							
E. KINGBIRD	444	6/5		14/10	14/13	16/14		50/42
W. KINGBIRD.	447	7/6		4/2		1/1		12/9
GT. CREST FLYCATCHR	452							
E. PHOEBE	456							
SAY'S PHOEBE	457	8/8	6/6	2/2	2/2	6/6		24/24
WILLOW FLYCATCHER	4664							
LEAST FLYCATCHER .	467	1/1		1/1				2/2
E. WOOD PEWEE . . .	461							
W. WOOD PEWEE . .	462	1/1		1/1				2/2
HORNED LARK	474	277/47	56/25	103/34	8/6	121/41		565/153
TREE SWALLOW . . .	614							
BANK SWALLOW . . .	616							
ROUGH-WG. SWALLOW	617			3/1	2/1	10/5		15/7

	(65)	(69)	(72)	(75)	(78)	(81)	(84)	(88)
Species	AOU	ROUTE						TOT.- INCL. SPETER
		C	E	P	M	D		
BARN SWALLOW . . .	613	11/6	1/8	9/7	12/5	1/1		42/27
CLIFF SWALLOW . . .	612	77/5	242/10	1/1	41/2	6/4		367/22
PURPLE MARTIN . . .	611							
BLUE JAY.	477							
BLK-BILLED MAGPIE .	475	1/1	6/4	9/5	16/8	10/8		42/26
COMMON CROW . . .	488				22/12			22/12
BLK-CAP. CHICKADEE	735							
WHITE-BR. NUTHATCH	727							
HOUSE WREN	721	2/2		4/2	21/14			27/18
LONG-BIL MARSH WREN	725							
SHORT-B. MARSH WREN	724							
ROCK WREN.	715		44/21	2/2	1/1	14/9		61/34
GRAY CATBIRD. . . .	704				1/1			1/1
BROWN THRASHER . .	705	1/1	2/2	8/6	10/8	14/11		35/28
SAGE THRASHER . . .	702							
AM. ROBIN	761	2/2		1/1	2/2	1/1		6/6
VEERY.	756							
E. BLUEBIRD	766							
MOUNTAIN BLUEBIRD	768				X			X
SPRAGUE'S PIPIT . . .	700		2/2			12/11		14/13
CEDAR WAXWING . .	619							
LOGGERHEAD SHRIKE.	622	2/2	1/1	7/6	3/3	5/5		18/17
STARLING.	493	10/2			6/3	27/1		43/6
RED-EYED VIREO . . .	624							
WARBLING VIREO. . .	627	1/1	1/1	1/1	1/1			4/4
YELLOW WARBLER . .	652	2/1		3/2	3/3	1/1		9/7
COM. YELLOWTHROAT	681	6/4		4/3	12/8	2/1		24/16
YELLOW-BR. CHAT. .	683			4/2	5/4			9/6
AM. REDSTART. . . .	687							
HOUSE SPARROW . . .	6882	51/8			1/1	5/1		57/10
BOBOLINK.	494	2/2				1/1		3/3
W. MEADOWLARK . .	5011	139/47	[illegible]/49	189/48	202/48	196/56		931/242
YEL-HD. BLACKBIRD.	497	3/2			10/3	2/2		15/7
RED-WG. BLACKBIRD.	498	83/30	13/6	35/15	72/13	45/16		248/80
ORCHARD ORIOLE . .	506			1/1				1/1
NORTHERN ORIOLE .	507	1/1						1/1
BREWER'S BLACKBIRD.	510		14/11	2/2	28/15	15/7		60/35
COMMON GRACKLE .	511				4/2			4/2
BROWN-HD. COWBIRD	495	27/12	22/18	38/21	12/6	29/20		128/77
ROSE-BR. GROSBEAK .	595							
BLACK-HD. GROSBEAK	596							
BLUE GROSBEAK . . .	597							
INDIGO BUNTING . .	598							
LAZULI BUNTING . .	599				1/1			1/1
DICKCISSEL.	604							
AM. GOLDFINCH. . .	529			3/2	18/9	4/3		25/14
RUFOUS-SIDE TOWHEE	587		1/1	6/6	15/12	4/4		26/23
LARK BUNTING. . . .	605	13/5	1/1	77/8	30/7	2/2		123/23
SAVANNAH SPARROW	542	1/1		1/1		1/1		3/3
GRASSHOPPER SPARROW	546	15/11	4/3	8/5		32/16		59/35
BAIRD'S SPARROW. . .	545					5/5		5/5
VESPER SPARROW . . .	540	11/6	39/21	20/16	21/16	21/17		112/76
LARK SPARROW	552		3/3	2/2	14/8	2/2		21/15
CHIPPING SPARROW. .	560							
CLAY-COL. SPARROW	561				8/5			8/5
BREWER'S SPARROW. .	562		27/16	6/5		4/2		37/23
FIELD SPARROW. . . .	563			6/6	18/15			24/21
SWAMP SPARROW. . .	584							
SONG SPARROW. . . .	581							
MCCOWN'S LONGSPUR	539	22/12						22/12
CH-COL. LONGSPUR .	538	143/43	14/8			62/24		219/75
WHITE PELICAN . .					X			X
GOLDEN EAGLE . .						X		X
. . . .								
. . . .								
. . . .								
. . . .								
. . . . .								

Form 3-6 (1975)

MAILING ADDRESS JULY 1980 Zip Code

	(65)	(69)	(72)	(75)	(78)	(81)	(84)	(88)
Species	AOU	ROUTE						TOT. INCL. OPECER
		C	F	P	M	D		
PIED-BILLED GREBE	006					1/1		1/1
DBL-CR. CORMORANT	120					X		X
GREAT BLUE HERON	194				1/1			1/1
BLK-CR. NIGHT HERON	202							
AM. BITTERN	190							
MALLARD	132				1/1	24/5		25/6
GADWALL	135							
PINTAIL	143							
GREEN-WINGED TEAL	139							
BLUE-WINGED TEAL	140					1/1		1/1
AM. WIGEON	137	1/1				3/2		4/3
N. SHOVELER	142							
WOOD DUCK	144							
REDHEAD	146							
CANVASBACK	147							
LESSER SCAUP	149							
RUDDY DUCK	167							
RED-TAILED HAWK	337							
SWAINSON'S HAWK	342					X		X
FERRUGINOUS HAWK	348		1/1			X		1/1
MARSH HAWK	331	2/2	3/3	2/2	X			7/7
AM. KESTREL	360	1/1	2/2		2/2			5/5
SHARP-TAIL. GROUSE	308			5/2		2/1		7/3
BOBWHITE	289							
RING-NECK PHEASANT	3091	8/7		7/6	34/26	3/3		57/42
GRAY PARTRIDGE	2881	1/1			1/1	2/1		4/3
SORA	214							
AM. COOT	221							
KILLDEER	273	11/8	4/4	24/19	16/15	28/15		83/61
COMMON SNIPE	230							
LONG-BILLED CURLEW	264				1/1			1/1
UPLAND SANDPIPER	261			5/4	4/3			9/7
SPOTTED SANDPIPER	263		1/1					1/1
WILLET	258							
MARBLED GODWIT	249							
AM. AVOCET	225							
WILSON'S PHALAROPE	224					3/1		3/1
RING-BILLED GULL	054					3/1		3/1
FRANKLIN'S GULL	059							
BLACK TERN	077							
ROCK DOVE	3131							
MOURNING DOVE	316	29/13	56/32	58/29	69/37	28/16		240/126
YELLOW-BIL. CUCKOO	387							
BLACK-BILL CUCKOO	388				X			X
GREAT HORNED OWL	375							
BURROWING OWL	378				2/1			2/1
SHORT-EARED OWL	367							
COMMON NIGHTHAWK	420	7/2	2/2	4/3	25/12	9/6		43/25
CHIMNEY SWIFT	423							
BELTED KINGFISHER	390							
COMMON FLICKER	412		1/1		8/6			9/7
RED-HD. WOODPECKER	406				5/5			5/5
HAIRY WOODPECKER	393							
DOWNY WOODPECKER	394							
E. KINGBIRD	444	3/3	3/2	6/6	14/13	20/13		46/37
W. KINGBIRD	447	6/6			5/5	3/1		14/12
GT. CREST FLYCATCHR	452							
E. PHOEBE	456							
SAY'S PHOEBE	457	5/5	3/2		1/1			9/8
WILLOW FLYCATCHER	4664							
LEAST FLYCATCHER	467	1/1						1/1
E. WOOD PEWEE	461							
W. WOOD PEWEE	462	1/1						1/1
HORNED LARK	474	138/46	10/6	64/24	13/7	68/32		293/123
TREE SWALLOW	614							
BANK SWALLOW	616	3/3				1/1		4/4
ROUGH-WG. SWALLOW	617			1/1	2/1	14/5		17/7

Form 3-6 (1975)

	(65)	(69)	(72)	(75)	(78)	(81)	(84)	(88)
Species	AOU	ROUTE						TOT. INCL. OPECER
		C	F	P	M	D		
BARN SWALLOW	613	1/4	4/2	15/8	7/4			31/18
CLIFF SWALLOW	612	23/10	36/23		50/1	34/6		173/40
PURPLE MARTIN	611							
BLUE JAY	477							
BLK-BILLED MAGPIE	475		13/5	9/3	26/14	17/9		65/31
COMMON CROW	488				23/15			23/15
BLK-CAP. CHICKADEE	735			1/1				1/1
WHITE-BR. NUTHATCH	727							
HOUSE WREN	721			4/3	15/11			19/14
LONG-BIL MARSH WREN	725							
SHORT-B. MARSH WREN	724							
ROCK WREN	715		31/18	3/3	3/3	8/5		45/29
GRAY CATBIRD	704			1/1				1/1
BROWN THRASHER	705			1/1	X			1/1
SAGE THRASHER	702							
AM. ROBIN	761	2/2		2/2	2/2			6/6
VEERY	756							
E. BLUEBIRD	766							
MOUNTAIN BLUEBIRD	768		2/1					2/1
SPRAGUE'S PIPIT	700					9/8		9/8
CEDAR WAXWING	619							
LOGGERHEAD SHRIKE	622	3/3	6/5	6/5	5/2	9/5		29/20
STARLING	493	23/4			1/1			24/5
RED-EYED VIREO	624				1/1			1/1
WARBLING VIREO	627				1/1			1/1
YELLOW WARBLER	652	1/1		2/2	5/4			8/7
COM. YELLOWTHROAT	681	4/4		2/1	17/11	3/3		26/19
YELLOW-BR. CHAT	683			3/1	14/11			17/12
AM. REDSTART	687							
HOUSE SPARROW	6882	45/9	1/1	5/3	3/2	3/3		57/18
BOBOLINK	494							
W. MEADOWLARK	5011	38/24	24/20	48/28	90/37	55/31		255/140
YEL-HD. BLACKBIRD	497							
RED-WG. BLACKBIRD	498	78/20	2/1		37/12	12/10		129/43
ORCHARD ORIOLE	506			1/1				1/1
NORTHERN ORIOLE	507				2/1	1/1		3/2
BREWER'S BLACKBIRD	510	62/5		4/2	38/10	26/8		130/25
COMMON GRACKLE	511				1/1			1/1
BROWN-HD. COWBIRD	495	15/6		11/6	18/4	22/7		66/23
ROSE-BR. GROSBEAK	595							
BLACK-HD. GROSBEAK	596							
BLUE GROSBEAK	597							
INDIGO BUNTING	598							
LAZULI BUNTING	599				1/1			1/1
DICKCISSEL	604							
AM. GOLDFINCH	529	3/1	1/1	10/6	31/15	1/1		46/24
RUFOUS-SIDE TOWHEE	587			8/6	24/17	7/6		39/29
LARK BUNTING	605	92/16		13/9		3/2		108/27
SAVANNAH SPARROW	542	1/1						1/1
GRASSHOPPER SPARROW	546	1/1				4/3		5/4
BAIRD'S SPARROW	545				1/1			1/1
VESPER SPARROW	540	5/4	7/6	8/7	20/14	3/3		43/34
LARK SPARROW	552	4/3	8/7	15/10	16/14	4/2		47/36
CHIPPING SPARROW	560				1/1			1/1
CLAY-COL. SPARROW	561				7/4			7/4
BREWER'S SPARROW	562					2/2		2/2
FIELD SPARROW	563			9/8	40/28	1/1		50/37
SWAMP SPARROW	584							
SONG SPARROW	581							
MCCOWN'S LONGSPUR	539	12/7						12/7
CH-COL. LONGSPUR	538	26/16				9/7		35/23
GOLDEN EAGLE			1/1					1/1
SAGE GROUSE				1/1				1/1
PRAIRIE FALCON						1/1		1/1

APPENDIX D

Circle West Dendritic Coulee Foot Routes

Field Instructions

Objectives

This study would document seasonal wildlife diversity and use of the silver buffaloberry/dendritic coulee habitat within the Permit Area, as well as the extent of coulee-related habitat use by individual species. All vertebrate species--amphibians, reptiles, birds,and mammals--would be investigated while walking two survey routes, as shown in Figure 25.

Materials Needed

Materials needed for each month of field study would include: a 1:4,800 map showing the two survey routes; a 7.5' field map; wildlife data sheets, and waterfowl observation data sheets (on which to record big game, other mammals, waterfowl, and raptor observations); two U.S. Fish and Wildlife Service Breeding Bird Survey (BBS) field sheets (one for each route) on which the 11 data entry columns have been reduced to four by drawing three heavy vertical lines between columns 3 and 4, 6 and 7, and 9 and 10; one U.S. Fish and Wildlife Service BBS summary sheet; binoculars; a 20x spotting scope; a clipboard; indelible pens; rain gear; field guides.

Methods

During each month of field study, the survey routes shown in Figure 25 should be walked once in a clockwise direction beginning at the MC05 dam at local sunrise. Emphasis should be placed on assessing vertebrate use of tall coulee shrub and other coulee habitats, although grassland and other noncoulee habitats should be surveyed as well. The following should be recorded on each field sheet at the beginning and end of the route: time, date, observer(s), wind speed (Beaufort scale), sky conditions (% clouds), temperature, precipitation type and rate, percentage of snow cover, and average snow depth (in inches). Each individual vertebrate observed (seen or heard) should be recorded by placing a hash mark in one of the four data entry columns on the BBS field sheet (according to the habitat where first observed) as follows:

Column 1 = using tall coulee shrubs directly, whether for perching, nesting, feeding, cover, or shade. Includes birds first seen flying into or out of tall coulee shrubs.

Column 2 = using other coulee habitats (coulee walls, sagebrush, water, bare earth, snowberry-rose), but not using all shrub habitats.

Column 3 = seen flying over or traveling across coulee, but not using coulee habitats directly.

Column 4 = seen or heard only on grassland or other habitats outside the coulee system.

Enter the hash mark according to the category in which the animal was first seen or heard. For example, if an animal was first seen in grassland above a coulee head and immediately entered tall coulee shrubbery, it would be entered in column 4. Each individual animal should be recorded only once; if it is not known whether an individual animal has already been recorded, do not record it again. This is particularly important in the case of deer and raptors, because the same individual may be seen many times while surveying a transect. Distant coulees and hillsides which are not traversed by the routes should be scanned carefully with the spotting scope at intervals along the route. Coulees adjacent to the route should be glassed carefully with binoculars. Generally, researchers should walk along the rim of the coulee to obtain the greatest field of view. However, in portions of the route where coulees are wide and shallow, it may be better to walk the coulee bottom. All vertebrates seen or heard, even those not identified, should be recorded. If it is not possible to identify a vertebrate by species, it should be identified as precisely as possible: "unknown gull," "unknown frog or toad," "unknown rabbit," "unknown passerine," etc. All observations of raptors, large mammals, amphibians, and raptiles should be recorded on 7.5' field maps and on standard wildlife data sheets (DNRC 1978:220,226). Waterfowl observations should be recorded on separate waterfowl data sheets. Details of any nests located should be recorded on nest record cards. Each route survey should take about 4.0 hours to complete.

At the end of the second route, the minimum estimate of the number of animals of each species recorded for the two routes combined should be summed for each of the first four columns on the BBS summary sheet (the meaning of each of the four columns is as defined above; the fifth column should be left blank). The four columns should then be summed for each species in the "total individuals" column. At the top of the summary sheet the date, observer, total hours spent for the two routes combined, and the number of different species of amphibians, reptiles, birds, and mammals observed should be recorded.

APPENDIX E

Circle West Dendritic Coulee Habitat Description

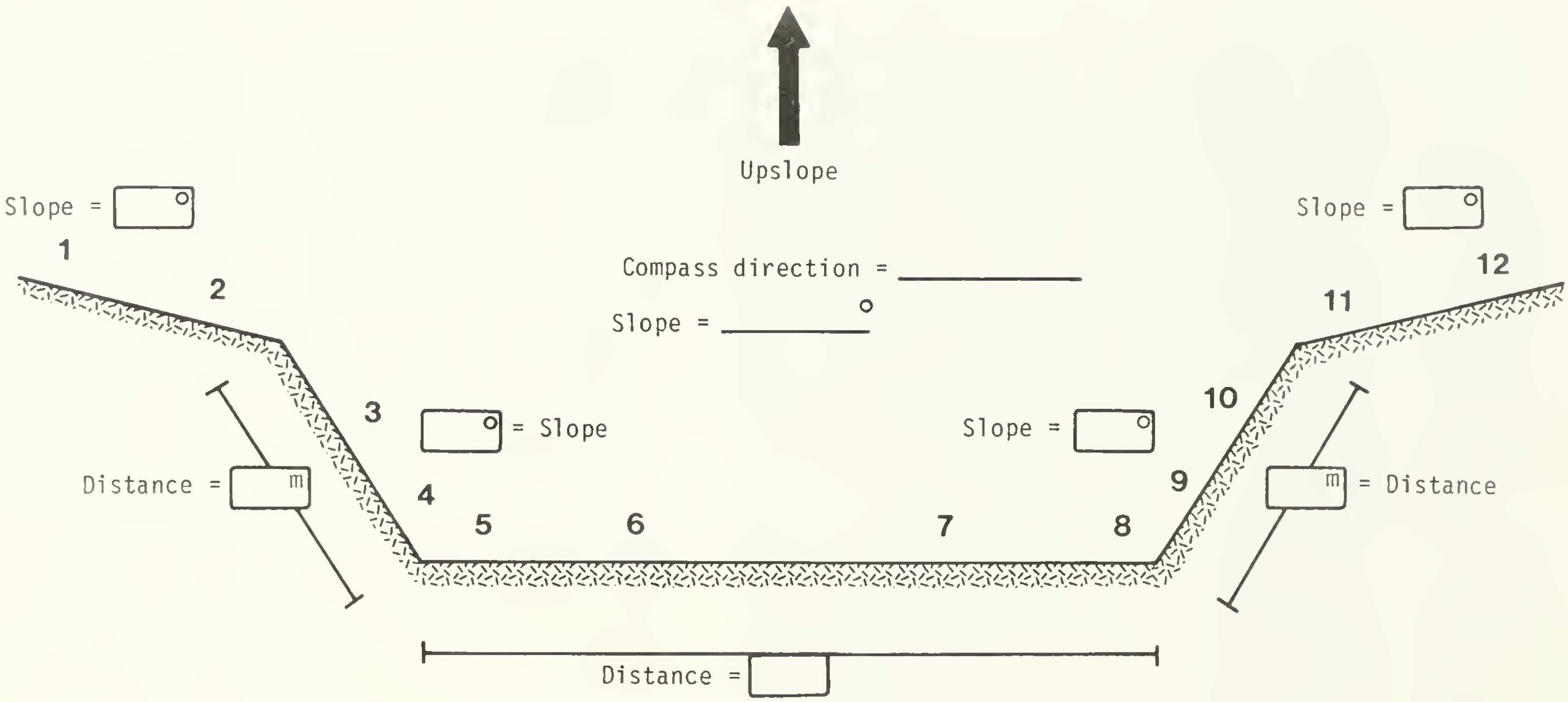
This study is designed to fulfill three objectives: first, to provide a quantitative, premining description of the dendritic coulee habitats in the permit area, including topographic structure, species composition and density, autecological distribution of key species, vertical layering, and wildlife cover suitability; second, to investigate the major topoedaphic factors related to the presence of the tall shrub type; and third, to investigate the age, origin, reclaimability, and trend of the coulee system in the study area. The last objective cannot be fully met until simultaneous geology, soils, and hydrology studies have begun. Nevertheless, the present study will provide some preliminary hypotheses and a basis for future interdisciplinary study.

Several different coulees should be selected for study. Most of these should be densely vegetated, deeply cut coulees, generally with a northeast aspect, within the coulee system outlined in Figure 23. Some of the sparsely vegetated west- and south-facing coulees just over the Nelson-McGuire Creek divide also should be studied to provide data on coulees with different slopes and aspects. Transects should be drawn perpendicular to the direction of flow across each coulee on 1:4,800 topographic maps. These transects should be sited as follows: beginning at the head of each coulee or each side branch over 65 m long, transects should be drawn at intervals of 5, 10, 15, 50, 100, 100, 100...meters downslope. The transects thus drawn should be investigated in the field, and those that are located at the junctions of coulee arms and are otherwise unrepresentative, or are duplicative, should be dropped until approximately 200 transects, representing a variety of slope, aspect, and vegetative conditions, remain.

At each transect, a number of topographic and vegetative features should be described on a data sheet similar to that shown in Figure 26. These should include: aspect, sideslope, drainage steepness, depth, width, distance to drainage head, general vegetation type, intensity of livestock use, and elevation. Twelve 2 x 5 dm plots should be located at standard positions along each transect, as shown in Figure 26. Pairs of plots should be located in corresponding positions on the left and right sides of the coulee as follows: 1 m and 3 m upslope from the coulee rim; 1 m and 3 m upslope from the outer edge of the coulee bottom; and 1 m and 3 m toward the center of the coulee from the outer edge of the coulee bottom. In cases where two plots would overlap because the coulee is too narrow or shallow and an overlap cannot be avoided, a new plot should be established midway between their centers. Data from this new plot should be entered for both of the original plots.

At each of the plots, the vertical structure of vegetation should be measured using the profile board technique developed by Nudds (1977). Intervals used should be 0-25 cm, 25-50 cm, 50-100 cm, 100-200 cm, and 200+ cm. The proportion of each interval covered by each plant species and by all vegetation in the study plot should be estimated to be nearest 5% and recorded. (Note: the total coverage should equal the sum of the proportions of coverage of individual species and should never exceed 100%.) Readings should be taken from a point exactly 7 m downstream from the profile board. For plots situated on steep coulee walls, care should be taken to read the profile boards with eye level at about 180 cm. These data should be used to determine foliage height diversity for each plot and shrub species diversity for each stratum. Coverage of individual species and of total species, litter, rock, bare ground, moss, and lichens in one 2 x 5 dm quadrant (Daubenmire 1959) located immediately downstream from the profile board should be recorded. Number and diameter of all silver buffaloberry trunks and maximum vegetation height also should be recorded within a one milacre plot (7.5 ft diameter) centered on the quadrant.

Using individual plots as samples, factor analysis should be used to explore relationships among the variables measured. Stepwise regression should be used to further clarify relationships between vegetation and key topoedaphic parameters. Silver buffaloberry trunk diameters should be used to create an age structure pyramid by employing the age-diameter regression equation of Hladek (1971).



Transect No.________Lowest Elevation____________ft. Main trunk or side? (circle one)

Greatest distance to head____________ft.

Distance to next lower junction with a larger branch____________ft.

Greatest distance to head from next lower junction with a larger branch__________ft.

Intensity of cattle use__________________ Photos__________________

General vegetation type (circle one): tall shrub, low shrub, grassland, badlands

Soil texture___________________

Figure 26. Circle West dendritic coulee habitat description data sheet.

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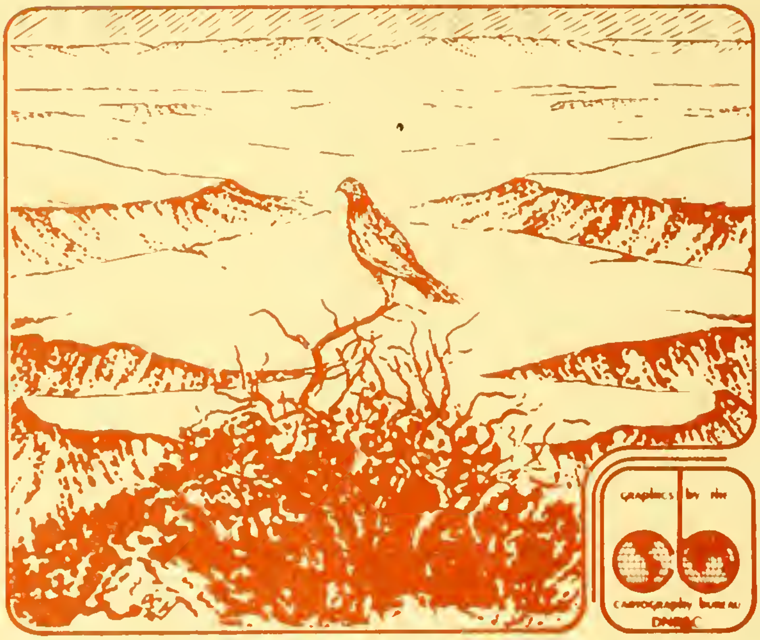
& CONSERVATION

Helena, Montana



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